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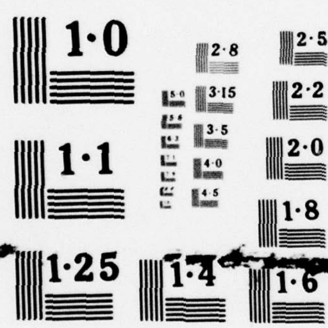

NATIONAL BUREAU OF STANDARDS
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BIBLIOGRAPHIC LITERATURE SEARCH CONCERNING THE RELATIONSHIPS BETWEEN SOILS AND PLANTS IN ARID AND SEMI-ARID REGIONS IN NORTH AMERICA

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MICHAEL INGLIS
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ALBUQUERQUE, NEW MEXICO 87131

DECEMBER 1978

FINAL REPORT

PREPARED FOR
U.S. ARMY ENGINEER TOPOGRAPHIC LABORATORIES
FORT BELVOIR, VIRGINIA 22060

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Phytogeography	Environmental factors
Arid/semi-arid climates	
Plant/soil water relationships	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A review of 79 journals, professional papers, and other periodicals for the period January 1950 through 1978, identified approximately 400 published references pertaining to plant species or plant communities as indicators of general or specific environmental conditions in the arid and semi-arid regions of the southwestern United States. A matrix illustrating the vegetation/factor interrelationship(s), and the reference describing the relationship(s) was produced for easy recognition and accession of specific abstracts provided.

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PREFACE

This report was prepared by Michael Inglis (Geologist), Denise Glore (Biologist), and Lynn Price (Biologist), Technology Application Center, University of New Mexico, Albuquerque, New Mexico.

The study was performed for the U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia, and was funded under Project No. 4A161102B52C, Work Unit 1852CS30010, "Indicators of Terrain Conditions."

Review of this report was accomplished by Mr. Melvin B. Satterwhite, Center for Remote Sensing, Research Institute, U. S. Army Engineer Topographic Laboratories, Fort Belvoir, Virginia.

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INTRODUCTION

Introduction

This bibliographic literature search "The Relationship Between Soil Properties and Vegetation in Arid and Semi-arid Regions of North America" was undertaken to provide a compendium of the available literature regarding the indicator relationship of plant communities to certain aspects of their environment, specifically soil and soil characteristics. The search was designed to provide: 1) information to aid managers and natural resource specialists working in areas concerning the relationship of plants to their environments in arid and semi-arid zones, 2) information useful to field researchers investigating any aspect of the interrelationship between plants and soils, and 3) an indication of arid and semi-arid regions lacking in relevant data (i.e., Montana, Wyoming, Mexico, etc.).

Methodology

The search was conducted in three phases as follows:

Phase 1 - A list of keywords was compiled (see Table 1) and a computerized literature search conducted on the following files:

a. BIOSIS

b. GEOREF

c. AGRICOLA

d. ENVIROLINE

It became apparent that use of the computer files was not a satisfactory approach to

the comprehensive retrieval of available literature. For example, keying the words plant/soil/relationship/arid/semi-arid/ into the BIOSIS line resulted in 169 citations, 19 of which appeared relevant.

Because of the poor computer response, an exhaustive manual search was conducted by first listing all journals, scientific and technical reports, manuscripts and government publications possibly related to the subject, including botanical, biological, range management, agricultural, silvicultural, ecological, and geological publications (Table 2).

Journals were reviewed, when practical, to the base year 1900, however journals found to be only slightly productive were reviewed to the year 1950.

Phase 2 - Abstracts of all pertinent articles were compiled. The citations were arranged alphabetically by author and numbered consecutively.

Phase 3 - A two-dimensional matrix was developed showing the relationship of plant communities to various characteristics of the soil. For each relationship a numbered entry was made corresponding to the numbered bibliographic citation from which the relationship was determined. In most cases, the same citation was entered into several different categories, and several

citations occurred for each indicator-factor relationship.

In addition, a map was numbered with entries corresponding to primary geographic areas discussed in each bibliographic citation. A preliminary report including an introduction, a listing of all related publications, 102 bibliographic citations, and a two-dimensional matrix was prepared and sent for a one month review by M. Satterwhite of USAETL. Once the preliminary report was approved, an extensive search was conducted of 79 publications, resulting in a total of 334 pertinent citations and 42 related references.

The present report contains the following elements:

1. A brief discussion of the geography of arid lands,
2. A listing of keywords used in conducting the computer search,
3. An alphabetical listing of all journals reviewed including volume numbers and/or dates that were searched,
4. A compendium of all bibliographic citations, arranged alphabetically by author and numbered consecutively.
5. A two-dimensional matrix showing indicator-factor relationships with numbered entries corresponding to the citation from which the relationship was established,
6. A map with numbered entries indicating the geographic location referred to in each citation, and
7. A compilation of related abstracts arranged alphabetically by author.

General Geography of the Semi-Arid Regions in Western United States

The semi-arid regions of the western United States have many climatic, geomorphological, soil, vegetation and zoological characteristics in common.

A primary characteristic of the climate of semi-arid regions is that annual rainfall is usually low and sporatic. Precipitation is not only meager in these areas, but it is also highly uncertain. The deviation from the annual average usually increases in direct proportion to the aridity of the area. Most storms occur due to convective activity, are of short duration, low volume and have a limited spacial extent. Very few of these storms produce channel flow and the orographic effect is very pronounced in the summer. Approximately 60-70% of the total annual precipitation, and practically all of the high-intensity rainfall which produces runoff, occurs from April to October. Due to prevailing conditions of cloudlessness, low relative humidity, and lack of water vapor in the air, the solar radiation is very intense in much of the semi-arid regions. These factors have a large bearing on the flora and fauna, including man, in semi-arid regions. Most of these regions are windy, spring often being the windiest time of the year.

Erosive activity in these regions is often quite high, due to the absence of vegetation cover, the impervious surface layer which forms in the soils, and the great intensity of the rain. Grey desert soils, sierozem, will form in areas throughout the western U.S. where the annual rainfall averages about 250mm per year and falls in irregular showers. With a limited amount of organic matter, these soils have free calcium carbonate at or just

below the surface. These soils develop beneath a vegetation known as "desert shrub" in the inner montane valleys of Colorado, Utah, and New Mexico. Sagebrush (Artemisia) and bunchgrasses are the most common components of this vegetation. Arid soils are characterized by their high content of various minerals. Gypsum is an important example.

In semi-arid regions where rainfall is higher and grasslands are more prevalent, soils tend to have a higher humus content. These are the chestnut brown soils. This soil profile contains calcium carbonate, so that the pedocalcic characteristics remain. Soils are generally saline in arid areas.

Vegetation in semi-arid areas is generally adapted to survive the lack of humidity, the high temperatures and radiation, and the winds and sandstorms which occur. Desert annuals usually sprout during the rainy season, grow rapidly and then initiate the seed stage with the coming of the dry season. Generally, semi-arid areas are characterized by sparse plant cover, much of which has a short growing season. Features which the xerophytic plants have adopted include a small number of leaves, the thickening of protective tissue, specialized root systems which maximize water uptake, and spines, thorns, and fiberous stems which cut down on herbivory.

General vegetation communities most frequently found in the semi-arid regions in western United States include pinon-juniper woodland (Pinus edulis) and (Juniperus spp.), chaparral - a scrubby growth consisting mainly of Gambel oak (Quercus gambeii), mountain mahogany (Cercocarpus spp.), and service berry (Amelanchier spp.), the sagebrush zone (Artemisia spp.), the shortgrass community, and the creosotebush shrubland. Gravel covered terraces at upper

elevations generally support sagebrush and grama grasses (Bouteloua spp.), whereas similar gound at lower altitudes is covered by shadscale (Artemisia confertifolia), and curly grass. Very sandy ground at upper elevations supports a variety of shrubs and some scrub oak, whereas this type of ground at lower elevations has mostly blackbush.

Impermeable ground on shaley formations supports low-growing mat saltbush (Atriplex spp.). Areas with loamy soil tend to be grassy. Cracks and crevices on rocky ledges have juniper (Juniperus spp.), mountain ash (Fraxinus spp.), scrub oak, and bitterbrush (Purshia tridentata). Much of the semi-arid lands in the western U.S. lack understory and ground litter, and therefore tend to be highly inflammable.

Semi-arid regions, by and large, do not support as large a number of animal species as other areas do. The animals which live there are highly adapted to their environment. Animals in these regions generally take advantage of the slightest relaxation in the harsher conditions by rapid reproduction and migration. Animals also tend to congregate in those areas most habitable. Much of man's activity in these regions has provided areas where conditions are more habitable.

The geomorphology of semi-arid regions is unique. Mountains and massifs tend to be discrete, slopes tend to be steep, relief is often quite angular, and there is much evidence of powerful sedimentation. A general absence of true soil is common, as are sheetfloods and mudflows. Generally, less than 20% of the region is covered by sand or dune fields. Most semi-arid regions are lower in elevation than surrounding mountains, and are often

basins without outlets. Thus, water collects in them and evaporates, leaving alkaline "pans."

In terms of more specific areas, west Texas, southern New Mexico and southeastern Arizona are characterized by rolling grasslands on the volcanic soils while creosotebush plains, cactus savannas and agave thickets occur on the limestone soils. Honey mesquite is common in dune areas and in many low flats and slopes along major drainways. There are numerous inland basins, some of which have ephemeral lakes. The general drainage is toward the Rio Grande. Mountain chains having a north-south or northwest-southeast orientation rise above the plains, along with dry rocky mesas.

Southwestern Arizona to the Colorado River is characterized by very low annual rainfall (about 4 inches), vast low sandy plains, scattered hills of highly eroded volcanic rock and low boulder-strewn mountain ranges of granite which run parallel to each other in a north-south direction. There are many intermittent small streams which are usually dry. Between these water courses are broad barren areas which are covered with numerous flat stones forming desert pavement.

In southeastern California, semi-arid areas drain into the Salton Sea or the Colorado River. Much of this area lies at, or just below, sea level. South of the Salton Sea there are very rich alluvial soils. The Colorado River has discharged huge loads of silt derived from the Colorado Plateau into this area.

North of the Salton Sea area, in southern California and southern Nevada, there is an upland semi-arid region with elevations of 2000-5000 feet above sea level. This area has little rainfall

(1.4 - 5.0 inches) which falls in winter and spring. The region is characterized by numerous parallel ranges of sharp, steeply sloped mountains with extensive gently sloping bajadas. These run in a general north-south direction. There are many well-formed undercones, weathered lava flows, layered deposits of volcanic ash, and layered beds of red sandstone.

The Great Basin area includes northeastern California, eastern Oregon, Nevada, Utah, southern Idaho and parts of Wyoming. This region is characterized by elevations of 2000 - 5000 feet above sea level. Parallel ranges of high, steep, thrust-fault or fault-block mountains traverse the area in a north-south direction. Between these mountains lie scattered low pinon-juniper covered ranges and broad sandy valleys.

In northern Arizona, southeastern Utah, and northwestern New Mexico there is a plateau land of rocky terrain surrounded by mountains and extensive flat-topped mesas. The altitude is about 3500 - 5500 feet above sea level. Much of this area is drained by the Little Colorado River.

-Denise Glore

Citations:

1. Bridges, E. 1970. World Soils, Cambridge University Press, p. 64-66.

2. Hunt, Charles 1967. Natural Regions of the United States and Canada, W.H. Freeman & Co., San Francisco.

3. Jaeger, Edmund 1957. The North American Deserts, Stanford University Press, p. 33-49, 73-103, and 123-164.

TABLE 1

KEY WORD LISTING

adaptation
alkalinity
antecology
arid climate
Arizona
Artemisia
Atriplex
bibliographies
cactaceae
caliche
California
Canada
chaparral
Chihuahuan Desert
climate/vegetation relationships
desert plants
desert soils
distribution patterns
drainage
drought
environmental gradient
epiphytes
erosion
evergreen
euphorbiaceae
flood plains
flora
flowering
geology
Great Basin
habitats
halophyte
indicator
lakes
landforms
Larrea
leaves
life history
Mexico
microenvironments
mineral indicator
Mojave Desert
Nevada
New Mexico
North America
OALS
opuntia
perennials
phenology
phreatophyte
phytogeography
Pinus edulis
Pinus ponderosa
plant
plant communities
plant distribution
plant ecology
plant growth
plant morphology
plant nutrition
plant populations
playas
prairie soils
prosopis
range
relationships
roots
salt deserts
sand
semi-arid climate
shrubs
slope exposure
soil chemistry
soil depth
soil moisture
soil pH
soil properties
soils
soil structure
soil temperature
soil texture
soil water/plant relationships
southwest US
succession
succulents
systematics
Tamarix
Texas
Upper Sonoran life zone
Utah
vegetation
water table
xerophyte

TABLE 2
JOURNALS SEARCHED

1. Advances in Hydroscience, V 1-present
2. Ambio, V 1-present
3. Am. Assoc. for Advancement of Science Committee on Desert and Arid Zone Research, No. 1-present
4. Am. J. of Botany, 1976-present
5. Annals of Botany, 1978
6. Arid Lands Abstracts, No. 1-present
7. Arid Lands Research Newsletter, No. 14-present
8. Arid Zone, No. 1-26
9. Botanical Gazette, 1950
10. Botanical Review, 1935-present
11. Boyce Thompson Inst. for Plant Research Prof. Papers, V 1-24
12. Boyce Thompson Inst. for Plant Research Contributions, V 1,2
13. Cactus and Succulent J., 1975-present
14. California Univ. Publication in Botany, V 30-36
15. Can. J. of Botany, 1978
16. Can. J. of Earth Science, V 15
17. Contribution to Geol., Univ. of Wyoming, V 1-present
18. Desert Plant Life, V 13-24
19. Earth Science, V 1-present
20. Earth Science Bulletin, V 1-present
21. Earth Science Reviews, V 1-present
22. Ecology, No. 1-present
23. Ecological Monographs, all, V 1, 1931-present
24. Economic Geol. and Soc. of Econ. Geol. Bulletin, 1976-present

25. Environment, V 1-present

26. Environ. and Exper. Botany, V 16

27. Environ. and Exper. Geology, V 16

28. Environ. Geology, V 1-present

29. Environ. Mgmt., V 1-present

30. Environ. Pollution, V 15,16

31. Flora of Texas, 1942-

32. Geology, V 1-present

33. Geol. J., V 1-present

34. Geol. Magazine, 1975-present

35. Geol. Soc. Am. Bulletin, 1975-present

36. Geol. Soc. Am. Spec. Papers, 1964-present

37. Geophysical Prospecting, V 25,26

38. Harvard Univ. Arnold Arboretum, 1975-present

39. Harvard Univ. Gray Herbarium Contrib. No. 11

40. Int. Center for Arid and Semiarid Land Studies, ICASALS Publ. No. 1-present

41. J. Appl. Ecology, 1975-1978

42. J. of Ecology, 1950-present

43. J. of Hydrology, V 1-present

44. J. Range Mgmt., V 1-2, 8-9, 15-27, 38-present

45. J. of Soil and Water Conserv., 1963, V 18(3)

46. J. Soil Science, V 27

47. Land, V 13

48. Leaflets of West. Botany, 1950-present

49. Mondrano, 1970-present

50. Nat. Resources J., V 1

51. North Am. Flora, 1958

52. North Am. Forest Soils Conf. Papers, V 2,3

53. Plant and Soil, 1977-present

54. Soil Science, V 14, 1922; V 59-, 1945-

55. Soil Science Soc. of Am. J., V 40-present

56. Soil Science Soc. of Am. Proc., 1967-present

57. Southwestern Naturalist, all, V 1-present

58. U.S. Bureau of Land Mgmt., Public Lands Statistics, 1959

59. U.S. Bureau of Mines, Minerals Yearbook, 1951

60. U.S. Dept. of Ag. Yearbook of Ag., 1966

61. U.S. Dept. of Handbook, 1949

62. U.S. Geol. Survey Bulletin, No. 1

63. U.S. Geol. Survey New Publications, 1967

64. U.S. Geol. Survey Prof. Papers, No. 1

65. U.S. Inter-Mountain Forest and Range Exper. Stn., U.S. Forest Service Bulletin, Ogden, UT, No. 2, 1963

66. U.S. Rocky Mountain Forest and Range Exper. Stn., Fort Collins, CO, Rept. 1953-1956, 1958-1968

67. U.S. Rocky Mountain Forest and Range Exper. Stn., Paper RM, No. 4, 1964

68. U.S. Rocky Mountain Forest and Range Exper. Stn., Res. Note RM No. 2, 1963

69. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Montana, 1970

70. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Nevada, 1970

71. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Oregon, 1970

72. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Utah, 1970

73. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Washington, 1970

74. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for West. U.S., including Columbia R. in Canada, 1968

75. U.S. Soil Conserv. Service, Water Supply and Snow Surveys for Wyoming, 1970

76. Utah Juniper, V 7,14

77. Water, Air, and Soil Pollution, V 1-present

78. Water Resources Bulletin, V 13,14

79. Water Resources Review, V 1,2

SECTION II

VEGETATION-ENVIRONMENTAL FACTOR MATRIX

	GRASSLAND	DESERT VEGETATION	RANGELAND	SHRUBLAND	WOODLAND	SPECIFIC SPECIES	SPECIFIC COMMUNITIES	GENERAL VEGETATION
SOIL MOISTURE	6, 67, 63, 69, 73, 77, 79, 90, 125, 138, 140, 141, 142, 160, 180, 181, 190, 194, 201, 207, 208, 262, 278, 282, 314	22, 47, 96, 108, 122, 123, 146, 169, 173, 174, 179, 186, 239, 240, 241, 253, 263, 267, 268, 284, 286	190, 209, 295, 330	2, 13, 43, 45, 63, 90, 96, 122 128, 141, 160, 241	88, 110, 121, 132 175, 278, 322, 326	15 - Larrea 23 - Astragalus tridens 25 - Sage 53 - Cacti 74 - Larrea 91 - Aristida & Agropyron 147 - Euphorbia 195 - Adenostoma 205 - Erigeron 244 - Koeleria 256 - Atriplex 306 - Lupinos 330 - Eurotia	201 - Riparian 237 - Playa	35, 39, 42, 44, 49, 57, 75, 90, 135, 185, 193, 196, 197, 201, 233, 252, 280, 285, 303, 316
SOIL DEPTH	8, 73, 138, 140, 180, 181, 274, 282	8, 94	144, 188, 209, 243	94, 312	88, 99	8 - Optunia 195 - Adenostoma		75, 81, 187, 283
SOIL TEMPERATURE	77, 90, 168, 194	123, 239		90, 209		15 - Larrea 53 - Cacti 195 - Adenostoma 205 - Erigeron 227 - Prosopis	14 - Montana	90, 185, 233
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GENERAL SOIL CHARACTERISTICS	9, 68, 80, 87, 112, 125, 138, 161, 164, 207, 216, 274, 313	26, 27, 28, 31, 54, 56, 62, 64, 82, 83, 87, 112, 117, 118, 145, 164, 182, 210, 211, 214, 219, 221, 251, 255, 265, 266, 271, 272, 273, 275, 276, 277, 325, 327, 332, 333	6, 223, 224, 225, 279	28, 33, 78, 80, 113, 143, 214, 222, 255, 301, 327, 328	28, 33, 71, 80, 109, 127, 175, 202, 228, 229, 327, 334	67 - Erigonum 70 - Pinus 74 - Larrea 86 - Juniperus 105 - Tridens 109 - Psuedotsuga 153,154,155,156, 157,158,308 - - Euphorbiaceae 203 - Eurotia-Atriplex 217 - Saguaro 218 - Purshia 232 - Sage 250 - Opuntia 310 - Nicotiana 329 - Larrea	107 - Riparian 245 - Playa	1, 3, 10, 11, 12, 38, 48, 54, 75, 80, 85, 97, 103, 104, 106, 114, 115, 116, 130, 131, 133, 148, 150, 151, 162, 170, 172, 189, 192, 202, 206, 215, 220, 231, 247, 252, 258, 269, 289, 296, 298, 300, 304, 318
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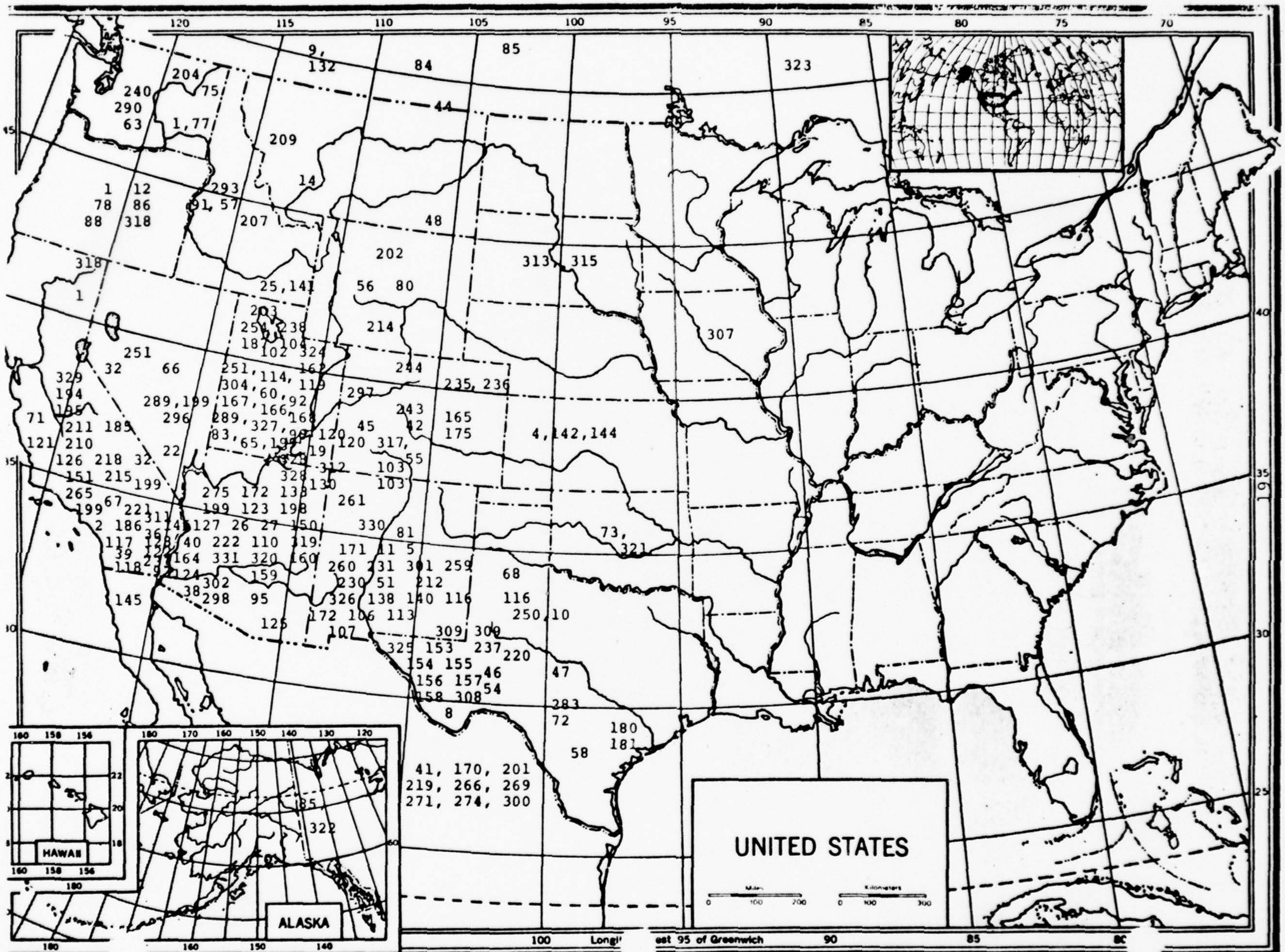
OUTSIDE INFLUENCES	80 - misc. 90 - grazing 216 - grazing 230 - grazing 321 - fires		236 - grazing 297 - grazing	2 - fire 80 - misc. 90 - grazing 238 - grazing	80 - misc.	86 - Juniperus/ fire 248 - Ribes/misc.		40 - fire 80 - misc. 90 - grazing 124 - misc. 148 - grazing 247 - grazing, fire
OTHER						24 - Chenopodiaceae & soil fungus		


UNITED STATES
HAWAII
ALASKA
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Kilometers
95 of Greenwich
NYSTROM Division of Carnation Company Chicago

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SECTION III

LITERATURE CITATIONS AND ABSTRACTS

Abrams, L

1940-1960

Illustrated Flora of the Pacific States: Washington, Oregon, and California, V. 4 with R. S. Ferris

Stanford University Press, Stanford, California, 4 vols.

Gives Keys, descriptions, synonyms. Species are illustrated by line drawings. Habitat, general distribution, life zones, flowering times, and often phytogeographic notes. Vol. IV includes a key to the families described in volumes I to IV and an index of common and scientific names.

Adams, S.; Strain, B.R.; Adams, M.S.

1970

Water-Repellent Soils, Fire, and Annual Plant Cover in a Desert Scrub Community of Southeastern California

Ecology 51(4):696-700

Surveys relating soil wettability and the establishment of annual plants were conducted on soil hummocks under burned and unburned shrubs and trees in a desert scrub community four years following a fire. Hummocks under burned and unburned Larrea divaricata, Prosopis juliflora, and Cercidium floridum were nearly devoid of established annuals, whereas surrounding soil was densely populated with several annual species, mainly Sphaeralcea emoryi. Water-repellent layers of soil were found at various depths in the barren hummocks, in general further below the soil surface under burned vegetation. The mosaic of annuals in the desert scrub vegetation is likely a result of the reduction of available soil moisture due to the formation of water-repellent soils under the shrubs. The effect was more pronounced following fire.

Addor, E. E.

1963

Vegetation Description for Military Purposes

Military Evaluation of Geographic Areas; Report on Activities to April 1963. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.,

Miscellaneous Paper 3-610:98-128

No abstract available

Albertson, F.W.

1937

Ecology of Mixed Prairie in West Central Kansas

Ecological Monographs, V.7, No.4, p. 481

Contents

The mixed prairie was first recognized as a distinct plant association by Clements (1920) who described its nature and range and the groupings of the dominants. Its relationships to true prairie and short-grass plains are further discussed by Weaver and Clements (1929). The association in Kansas occupies a broad belt across the western half of the state but gives way to true prairie near a central north-south line. Despite its importance and vast extent but few studies of an ecological character have been made in typical mixed prairie.

Bruner (1931) described the southward extension of mixed prairie through Oklahoma and its relation to true prairie and short-grass plains. Shantz (1911) gave an excellent discussion of the short-grass plains of eastern Colorado, especially that portion lying west of Kansas. The natural vegetation eastward from the Rocky Mountains to the 98th meridian from Canada to

Texas has also been described by Shantz (1923). Pool (1914) studied the sandhills of Nebraska, and Sarvis (1920, 1923) reported on the mixed prairie of central North Dakota. Numerous papers by Clements (1916, 1934, and 1936) elucidate many of the problems of the grasslands.

A comprehensive comparison of the environmental factors and growth of grassland vegetation in true prairie, mixed prairie, and short-grass plains was made by Weaver (1924) and Clements and Weaver (1924). The mixed prairie station, selected after extensive reconnaissance as centrally located, was maintained at Phillipsburg, Kansas, 70 miles due north of the area of the present research. The three years during which water content of soil, temperature, humidity, and evaporation were measured were, fortunately, years of average rainfall and indicate clearly the intermediate nature of the mixed prairie among grassland climates. Differences in vegetation and response to extreme drought in true and mixed prairie have been described recently by Weaver and Albertson (1936).

Aldon, E.F.; Brown, H.G.

1971

Geologic Soil Groupings for the Pinyon-Juniper Type on Nat'l Forests in New Mexico

US Forest Service, Rocky Mt. Forest and Range Experiment Stn., Ft. Collins, CO   Res. Note RM-197, 4 p.

This study relates the distribution of the Pinyon-Juniper communities of New Mexico to various geologic soil groups as determined from maps of the state. Almost 29 percent of the Pinyon-Juniper type is on highly unstable geologic formations that contribute to high sediment yields. Sedimentary units make up 54 percent of the acreage in the type, igneous units 39 percent, and pre-Cambrian formations 7 percent.

Anderson, Kling L.; Fly, Claude L.

1955

Vegetation-Soil Relationships in Flint Hills Bluestem Pastures

J. Range Management v.8 (4) :163

Change in species population may serve as a basis for evaluating the effects of grazing on range condition. However, it must also be recognized that vegetational composition varies from place to place independent of grazing influences and that populations on different soils may not respond alike to management treatments. Thus it becomes necessary to relate the vegetation to the site. In this study vegetational populations have been compared for different soils in the same climate. The experimental area was the Flint Hills bluestem pastures used in pasture utilization research at the Kansas Agricultural Experiment Station at Manhattan, Kansas. The purpose of the study was to associate vegetation with its environment as a basis for interpreting population changes and in segregating effects of grazing management practices from effects of site.

Aldous, A. E., Shantz, H. L.

1924

Types of Vegetation in the Semi-Arid Portion of the United States and Their Economic Significance.

Journal of Agricultural Research v.28 :99-127

A comprehensive discussion. Covers 102 mostly semiarid and arid types. Valuable for information on soil textures but includes nothing on precipitation or temperature.

Anthony, M. S.

1949

An Ecologic and Systematic Analysis of the Genus Opuntia Miller in the Bid Bend Region of Texas

University of Michigan (Ph.D. dissertation)

As a physiographic entity the Big Bend Region of southwestern Texas includes igneous and sedimentary rocks; shallow and deep soils; clay soils to sands, sub-humid to semi-arid and arid climates; xerophytic to mesophytic habitats; desert, arid grassland, encinal and montane belts of distinctive vegetation, and Rio Grande Flood Plain plant associations. It is a meeting ground for faunal and floral forms of four adjacent biotic provinces.

Ayyad, M. A. G., Dix, R. L.

1964

An Analysis of a Vegetation--Microenvironmental Complex on Prairie Slopes in Saskatchewan

Ecological Monographs v.34 (4) :421

Table of Contents

The complex interrelationships between plant growth, plant distribution and the physical environment are made sharply evident by slope and exposure-induced variations in the micro-environment. The contrasting heat regimes and vegetational characteristics of opposing north-south exposures are apparent to even the casual observer of the natural landscape. Variations more subtile than these contrasts are the rule in nature, however, and satisfactory quantitative descriptions and explanations of the vegetational changes which take place in response to gradual variations in slope and exposure usually require the application of the methodologies of several scientific disciplines. While considerable attention has been given to the interrelationships between plant distributions and physiographically controlled environmental factors in forest vegetation (Cantlon 1953, Cooper 1961, Loucks 1962), comparable grassland studies are few and not comprehensive in nature. The present study was made to add to our understanding of the interrelationships between the microenvironment and vegetational patterns in grasslands, particularly as these are influenced by exposure and position-induced variations within a local area. The rolling morainic topography of central Saskatchewan provides, on a local scale, a variety of slopes, exposures and positions which display varied habitat and compositional spectra and, therefore, offered a suitable landscape on which to implement this study.

The main objectives of the investigation were: (a) to study the variations in the composition of grassland vegetation as they are correlated with aspect and position, (b) to analyse the variations in the environmental factors which may be responsible for the species distributions, (c) to evaluate the degree of correlation between environmental factors, species behavior and vegetational pattern, and (d) to ascertain the degree of abruptness of phytosociological change which if great, would permit the recognition of separate vegetational units.

Bailey, V.

1905

Biological Survey of Texas

North American Fauna v.25 :1-222

One of a series of surveys vased on Merriam's life zones; includes material on the vegetation of the lower Sonoran zone of western Texas.

Bailey, V.

1913

Life Zones and Crop Zones of New Mexico

North American Fauna v.35 :1-100

Another in the series of surveys based on Merriam's life zones.

Bailey, V.

1936

The Mammals and Life Zones of Oregon

North American Fauna v.55 :1-416

Includes worthwhile material on the vegetation and environmental conditions of the state, although primarily zoological. Shows upper Sonoran zone in the southeast and east central north boundary along the Columbia River. States that the western arid division covers most of the Columbia and Snake River Balley of eastern Oregon and about half the higher sagebrush plains area of the state east of the Cascade Range.

Balding, F. R., Cunningham, G. L.

1974

The Influence of Soil Water Potential on the Perennial Vegetation of a Desert Arroyo

The Southwestern Naturalist v.19 (3) :241-248

The density, mean plant height and mean plant width of the perennial shrubs in a desert arroyo were compared with the soil water potential gradient along the arroyo during one growing season. The data indicated that the density of shrubs was negatively correlated with the soil water potential gradient and shrub crown size positively correlated with the gradient. The variation in the vegetation parameters could not be accounted for by the soil water potential gradient alone.

Bamberg, Samuel A., Major, Jack

1968

Ecology of the Vegetation and Soils Associated with Calcareous Parent Materials in Three Alpine Regions of Montana

Ecological Monographs v.38 (2) :127-167

Table of Contents

During ecological investigations in the Montana alpine region, striking differences were observed in the vegetation and soils developed on adjacent mountain ranges with different soil parent materials. The differences were most evident between those ranges with sodic (acid) igneous or metamorphic substrates and those with a predominantly sedimentary substrate, particularly limestone. Three calcareous alpine areas were intensively studied to determine just what were their botanical and pedological characteristics and to what site factors these characteristics were related.

This paper is, then, an ecological study of the interaction of soil parent material, in this case a calcareous substrate, with the vegetation component of some ecosystems in the alpine region of Montana. The variables studied were flora, vegetation, soil morphology and chemistry, soil temperature, and soil movement associated with frost action.

Barbour, M.G.

1958

Germination Requirements of the Desert Shrub Larrea divaricata

Ecology 49(5):915-923

Germination requirements of Larrea divaricata dav. were studied in the laboratory using seed collected at 34 US sites grouped into three desert regions (Chihuahuan, Sonoran, Mojave) of increasing aridity from east to west. Optimum laboratory conditions for germination were darkness, 23 C, leaching the mericarps with running water, wetting and drying cycles, exposure to cold temperatures prior to sowing, and maintaining the medium about the seeds near-zero in osmotic pressures and low in sodium chloride. Exposure of dry seeds to warm temperatures (37 to 71 C) prior to sowing resulted in marked reduction of germination. Maximum root growth was obtained at 29 C in a slightly acidic medium low in sodium chloride and near-zero in osmotic pressure. There were no regional differences in germination behavior. Due to seed abortion, non-germination, and mortality over six months growth, only 20 seedlings survive for every 100 mericarps sown under optimum conditions in the greenhouse. It is unlikely that large-scale germination and survival occur often in nature.

Barbour, Michael G.

1969

Age and Space Distribution of the Desert Shrub Larrea Divaricata

Ecology v.50 (4) :679

Field observations of Larrea divaricata Cav. throughout its United States range were used to determine: (1) the age distribution of stand members; (2) the spatial distribution of stand members; and (3) the magnitude of certain soil changes across abrupt community boundaries. Significant non-central tendencies in age distribution of most stands indicated that germination and survival are rare events, contributing to one-age or several-age stands. Shrubs were distributed at random, in clumps, or at regular intervals depending on the environment. Soil pH and salinity changes across ecotones were neither predictable nor usually great enough to affect germination and early growth of Larrea.

Barratt, B.C.

1964

A Classification of Humus Forms and Micro-Fabrics of Temperate Grasslands

J. Soil Science 15(2)

The humus form is recognized in a soil profile as the group of A horizons in which organic matter is concentrated, and it is thus the upper part of only the genetic humus type, the true measure of which is the complete organic profile extending into B and C horizons. Grassland humus forms are subdivided on a basis of field morphology into two groups: mull, in which the organic residues are largely incorporated as an intimate clay-humus misture, and mor, in which organis residues in varying stages of decomposition overlie the mineral soil with a sharp boundary but may show weak mechanical admixture of mineral grains. A mor-like mull intergrade is recognized where the mull is very high in intimately incorporated organic matter. According to variation in horizon thickness, structure, and consistence, sixteen humus forms are recognized: strongly granular, weakly granular, massive or blocky, fine, matted, laminated, and lenticular mulls, strongly granular, weakly granular, and laminated mor-like mulls, and granular, massive, matted, laminated, banded, and mullized mors. Where mineral grains are very abundant in mor, a sandy phase is recognized. Each layer or horizon of a humus form may have one or more distinct microstructures or fabrics. Twelve fabrics have so far been recognized under grassland: Weak mull humus, strong mull humus, mull-like moder, mull-like rendzina moder, leached mull-like rendzina moder, silica moder, swollen moder, rendzina moder, leached rendzina moder, raw soil humus, sclerotial humus, and raw humus.

Beath, O. A.

1941

The Use of Indicator Plants in Locating Seleniferous Areas in Western United States IV: Progress Report

American Journal of Botany v.28 (10) :887-900

The selenium content of 407 native and cultivated plants was determined. Seleniferous plants have been found in the Chinle, Wingate, Kayenta, Sundance, and Paradox formations in Arizona, New Mexico, Utah and Wyoming.
BA 16 (4) 8916

Beath, O. A.

1943

Toxic Vegetation Growing on the Salt Wash Sandstone Member of the Morrison Formation.

American Journal of Botany v.30 (9) :698-707

Beath found that native vegetation growing on the Salt Wash members of the Morrison formation in southeastern Utah was generally seleniferous; hence forages are hazardous to livestock in these areas. The occurrence of selenium-indicator plants on other formations was also noted.
BA 18 (3) 4106

Beath, O. A., Eppson, H. F., Gilbert. C. S.

1935

Selenium and Other Toxic Materials in Soils and Vegetation

Wyoming Agricultural Experiment Station, Bulletin 205, :56

One of a series of reports on selenium and other toxic materials in soils and vegetation.

Beath, O. A., Gilbert, C. S., Eppson, H. F.

1939

The Use of Indicator Plants in Locating Seleniferous Areas in Western United States II: Correlation Studies by States

American Journal of Botany v.26 (5) :296-315

No abstract available

Beatley, Janice C.

1967

Survival of Winter Annuals in the Northern Mojave Desert

Ecology v.48 (5) :745

Following early autumn germination in Mojave Desert winter annual populations (53 taxa) samples on 13 plots (total sample size, 16.4 m^2) in three drainage basins in southern Nevada, 1963-64, there was 38% survival to maturity (plot range 10-63%). Death occurred in early spring, at the time of shift from the slow vegetative growth of winter to the beginning of stem elongation. Despite no marked precipitation deficiencies during the 7-to 8-month growing season, mortality apparently resulted from inadequate soil moisture to meet the demands of all seedlings at the point in the life cycle of a manyfold increase in plant volume. Mean percentage survival to maturity of seedlings (58 taxa), sampled on 62 plots (total sample size, 62 m^2) in seven drainage basins, following spring germination after rains of 3-5.5 inches in March-April 1965, was 60% (range by basin, 44-83%). Mortality in these populations, whose life cycles were completed in 6-10 weeks, could not be attributed to inadequate moisture levels. In most seasons, regardless of precipitation regimes, the majority of seedlings of desert annuals probably do not survive to maturity.

Beatley, J.D.

1973

Perennation in Astragalus Lentiginosus and Tridens Pulchellus in Relation to Rainfall

Madrond 69(6):326-332

In late winter-early spring of 1965, unusually heavy rains fell at the Nevada test site in South-central Nevada. These were followed by conspicuously large numbers of A. lentiginosus (Leguminosae) and T. pulchellus (Gramineae). In late autumn, 1965, the rains were even heavier and were followed in the spring of 1966 by spectacular flowering populations of A. lentiginosus. On permanent study sites in the area, year-round data collections were kept on environmental variables and plant populations. Most of the astragalus seedlings lived to flower the following spring, then died. These were distinctly biennials. Perennial populations occurred mostly at higher elevations associated with more frequent and greater rainfall. Seeds of T. pylchellus may germinate in either spring or fall, and for the most part, the plants exhibit a winter annual growth regime. It appears that germination is dependent on soil moisture and perenniation is dependent on rainfall regularity. In plants such as Astragalus the ability to occur as annuals, biennials, or perennials may confer a high level of adaptability to a wide range of environmental conditions.

Becker, Donald A.

1978

Stem Abscission in Tumbleweeds of the Chenopodiaceae: Kochia

Amer. J. Bot. 65(4) :375-383

Anatomical, histochemical, and mechanical studies indicated the presence of a highly modified and weakened stem base in Kochia scoparia L. Schrader. This base, the abscission zone, is the site for stem abscission. In autumn progressive desiccation of the plant is accompanied by the gradual loss of stem flexibility and concomitant increase in rigidity. The tissues of the stem remain relatively tough, but abscission zone tissues become very brash or brittle. When conditioned plants are stressed by winds, the stem acts as a moment arm, and large stresses are generated in the abscission zone. Rupture then occurs across the stem base, often abruptly. Strength tests indicated that breakage occurred with 40% less stress if a soil-inhabiting fungus (Rhizoctonia sp.) had degraded the nonlignified cell wall components of the abscission zone. Abscission, therefore, is caused by the wind, an external driving variable, but tissue desiccation, changes in anatomy, and decay are internal, preparatory variables.

Belt, G.H.Jr.

1970

Spring Evapotranspiration From Low Sagebrush Range in Southern Idaho

Univ. of Idaho, Water Resources Res. Inst., Tech. Completion Rept., OWRR Proj. A-014-IOA(2), 44 p. Avail:NTIS as PR-196-349

Evapotranspiration has measured from low sagebrush covered range land at the Reynolds Creek Experimental Watershed, Reynolds, Idaho. The objectives of the study were to measure the magnitude of and variation in evaporative flux rates for low sagebrush range, and to identify those parameters of the microclimate which were significant in causing daily and hourly variation in flux rates. Evapotranspiration from the low sagebrush range (38 percent crown cover), using the Bowen-ratiotechnique, indicates typical ET rates of 0.025 to 0.40 mm per hour. Losses during daylight hours ranged from 1.27 to 3.0 mm and represented 33 to 46 percent of the net radiation. Advection of sensible heat was negligible. Soil moisture during the May-June period ranged from 17 to 40 percent by volume. The instrumentation developed for Bowen-ratio energy balance measurements is also described.

Benson, L.

1940

The Cacti of Arizona

University of Arizona, Biological Science Bulletin 11:1-134

A very readable description of the native cacti of Arizona, which includes plant descriptions, habitat, general range, altitudinal and geographic distribution within Arizona. Illustrations of 56 species, and distribution maps for 60 species.
BA 15 (8) 19191

Benson, L.

1950

The Cacti of Arizona, 2d ed.

University of New Mexico Press, Albuquerque :135

A popular discussion of the cacti of Arizona including notes on the structure of cacti, the differences between juvenile and adult forms, the identification and geographical distribution of cacti that occur in Arizona. Includes excellent photographs and maps showing occurrence and ecological areas.
BA 25 (10) 31743.

Benson, L., Darrow, R. A.

1954

The Trees and Shrubs of the Southwestern Deserts.

University of Arizona Press and University of New Mexico Press. Tucson and Albuquerque. :437

The first part of this book discusses desert climates and physiography, and includes an idealized profile through a desert mountain range and basin showing the vegetational types and soil conditions. The discussion includes the Mojave, Sonoran, and Chihuahuan deserts, and nature of the vegetation in each. Includes small maps showing the distribution of major species and color photographs of important species.

Bernstein, L.

1962

Salt-Affected Soils and Plants

The Problems of the Arid Zone, Proceedings of the Paris Symposium. Unesco, Paris. Arid Zone Research 18 :139-174

A comprehensive review of recent research related to salt-affected soils and plants. Discusses the occurrence, properties, and management of salt-affected soils, fertilizer requirements, indicator plants, and the tolerance of various plants to saline conditions.

Bidwell, G. L., Wooton, E. O.

1925

Saltbushes and Their Allies in the United States

U. S. Department of Agriculture, Bulletin 1345 :1-40

Discusses this group of plants very important in the northern desert shrub vegetation of North America. Gives descriptions, distribution, habitat, chemical analyses, forage value, and common names of many Chenopodiaceae. Includes good illustrations of desert vegetation and of individual species.

Billings, W. D.

1945

The Plant Associations of the Carson Desert Region, Western Nevada.

Butler University, Botanical Studies 7 :89-123

No abstract available

Billings, W.D.

1949

The Shadscale Vegetation Zone of Nevada and Eastern California in Relation to Climate and Soils

Am. Midland Naturalist 42(1):87-109

On the basis of fieldsampling, climatic data, and soil examination, the basin sagebrush association of clements is divided into two zones: sagebrush and shadscale. Each is a vegetation zone with a matrix community determined by climate. The matrices of the two zones are compared by quantitative samples of their dominant strata. The shadscale zone is characterized by a much drier climate than the sagebrush zone and lies between the sagebrush and creosotebush zones. The zonal soils under shadscale vegetation are gray desert soils while those of the sagebrush zone are usually darker, often brownish. These gray desert soils may or may not possess a degree of salinity in the subsoil. Embedded in the matrix of the shadscale vegetation are edaphic communities which are characteristic of intra-zonal or azonal soils.

Billings, W. D.

1950

Vegetation and Plant Growth as Affected by Chemically Altered Rocks in the Western Great Basin

Ecology v.31 (1) :62

During a preliminary survey of the vegetation of the western Great Basin, numerous isolated patches of yellow pine (Pinus ponderosa and P. jeffreyi) were observed in the sage-brush and pinyon-juniper zones some distance to the east of the pine forests of the Sierra Nevada. Unlike the usual post-climax extensions of forest into grassland or brush, most of these groves are on hill-sides or ridge-tops. They are remarkable also for their uniformly light yellowish soil which contrasts sharply with the brownish soils of the surrounding sagebrush or pinyon-juniper matrices.

The present study was undertaken primarily to discover the reasons for the presence of trees on upland soils of a climatic region dominated by shrubs. Secondarily, it offered an excellent opportunity to investigate the effect of different parent materials on the structure of vegetation within a climax region.

Billings, W. D.

1951

Vegetational Zonation in the Great Basin of Western North America

International Union of Biological Sciences, Ser. B, 9 :101-122

A detailed discussion of the vegetation of the Great Basin including portions of the Mojave and Colorado Deserts. The southern extension includes some of the hot deserts where creosotebush dominates. Temperature and precipitation data are included. The author believes that shadscale is the American representative of the cold desert. Sagebrush occurs at elevations above 4500 feet in the north and 5500 feet in the south, and occupies an area generally cooler in summer and colder in winter than shadscale.

Bingham, S.B.

1963

Vegetation-Soil Relationships in Two Stands of the Cercidium-Carnegiea Community of the Sonoran Desert

Univ. of Arizona, M.S. Thesis, 84 p.

Floristic and phytosociological features of plant communities on limestone vs. those on alluvial soils are compared. The area studied was in the low San Pedro Basin of southeastern Arizona (10 miles NW of Redington). Perennial vegetation in the area exists as a vegetational continuum following a gradient of soil moisture, with a more mesic perennial plant community associated with the limestone soils compared with topographically similar alluvial soils. Limestone soils, although of finer texture and with higher wilting coefficients, have a higher aggregation of fine particles and a greater amount of rock and gravel in the profile. A higher rate of infiltration and percolation of water with reduced run-off contributes to a greater amount of available soil moisture for the plant communities on limestone soils. These same factors contribute to a more xeric, edaphic situation for shallow-rooted annuals on the limestone soils. Differences in chemical properties of the two soil groups appear to restrict Parthenium incanum, Iva ambrosiafolia, Polygala macradenia, and Notholaena sinuata to limestone soils in the area studied.

Blake, W. P.

1914

The Cahuilla Basin and desert of Colorado in the Salton Sea, a Study of the Geography, Geology, Floristics, and the Ecology of a Desert Basin

Carnegie Institution of Washington, Publication 193

Although concerned primarily with geology, this work provides a very useful description of vegetation as related to geologocal features.

Blumer, J. C.

1909

On the Plant Geography of the Chiricahua Mountains

Science n.s. 30(777) :720-724

Includes discussion of vegetation of the Lower Sonoran (or Desert) zone, which is considered to include the area below 4500 feet, but may extend up to 6250 feet under certain soil and exposure conditions. Blumer notes that vegetation on transported soils from different sources differs nearly completely, that vegetation on residual soils derived from different materials differs greatly and bears no relation to aspect, and that recent volcanic soils are almost devoid fo trees and shrubs.

Blumer, J. C.

1912

Notes on the Phytogeography of the Arizona Desert

Plant World 15(8) :183-189

A description of desert vegetation during winter in Arizona.

Bradley, W.G.

1970

The Vegetation of Saratoga Springs, Death Valley Nat'l Monument, California

The SW Naturalist 15(1):111-129

The vegetation of Saratoga Springs and adjacent areas was sampled by means of one m^2 quadrats placed at four-m intervals along randomly located transects. The frequency of occurrence, average percent cover, and numbers of perennial species was computed for each community belonging to xerophytic shrub, phreatophytic shrub, and marsh vegetation types. Plant communities arranged along moisture and salinity gradients clearly indicate the importance of water availability and salt content of the soil. Xerophytic and phreatophytic shrub communities have fewer perennial species, lower percent cover, and a lower standing crop than plant communities within the marsh. In general, plant communities form a vegetation mosaic in the marsh and vegetation belts or zones along sharp environmental gradients (salt concentration and water availability) adjacent to the marsh.

Brady, Ward, Bonham, Charles D.

1976

Vegetation Patterns on an Altitudinal Gradient, Huachuca Mountains, Arizona

The Southwestern Naturalist v.21 (1) :55-66

Vegetation patterns were studied over an altitudinal gradient in the Huachuca Mountains, Arizona. The sequence of dominant species occurring from low elevation (1675 m) to high elevation (2750 m) was: Quercus emoryi, Juniperus deppeana, Quercus hypoleucoides, Pinus arizonica, and Pseudotsuga menziesii. With the exception of Pseudotsuga menziesii, all the above species had a unimodal distribution of canopy cover with respect to elevation change. Pseudotsuga menziesii, on the other hand, had a bimodal distribution of canopy cover which resulted from disturbance by fire. Communities dominated by Quercus gambelii occurred between modes in the Pseudotsuga menziesii distribution.

Species diversity of the vegetative communities was also observed over the gradient. Among stands approaching climax a trend for decreasing diversity with increasing elevation was apparent. The presence of seral communities on the gradient also allowed some inference to be made regarding succession and species diversity. These inferences support the hyposhesis that diversity first increases through the successional sequence and then shows some decrease as climax is closely approached.

Brand, D. D.

1936

Notes to Accompany a Vegetation Map of Northwest Mexico

University of New Mexico Bulletin, Biological Series 4(4, 27 p.

Includes a detailed map of vegetation types and their distribution, an extensive bibliography of articles on the flora of Mexico, and a history of vegetational studies of the region. The region is divided into vegetation areas, which include the Chihuahuan Desert, Sierra Madre Occidental, Sonoran Desert, and the Sinaloa Tropical. The Chihuahuan Desert includes three associations, creosote-mesquite, mesquite grassland, and succulent desert. The Sonoran Desert includes four associations: Colorado River delta, creosote-paloverde-cacti, Sonoran mesquite grassland, and subtropical mimosaceae-cacti.

Branson, F. A., Miller, R. F., McQueen, I. S.

1965

Plant Communities and Soil Moisture Relationships Near Denver, Colorado

Ecology v.46 (3) :311

Plant communities and some casual factors were studied on a stony soil, on pebble mounds on stony soil, and on an adjacent soil derived from the Pierre Shale in an area 14 miles northwest of Denver, Colorado, at approximately 6,000 ft. altitude. Average annual precipitation is 15.2 inches. The three dominant perennial species on the soil derived from Pierre Shale were buffalograss, blue grama, and western wheatgrass, all of which are characteristic of the mixed prairie association of the Great Plains. True prairie species characteristic of prairies of the Midwest, big bluestem, little bluestem, Indiangrass, switchgrass, and prairie dropseed, were present in significant amounts on the stony soil; however, most of the other species were montane. Some of the montane species were mountain muhly, sandwort, and beardtongue. More than twice as many species occurred on the stony than on the other two soil conditions.

The greater availability (lower tensions) of soil moisture in the stony soil appears to be the primary cause of the larger number of species and generally more mesic flora. Infiltration rates were highest on pebble mounds and stony soil. Although the stony soil contained less zinc, potassium, sodium, and sulfate, plant species from the stony soil contained larger quantities of these nutrients. The higher pH in the shale-derived soil (7.1 as compared to 6.0-6.3) and larger quantities of montmorillonitic clays may have reduced the availability of these nutrients to plants.

The presence of vegetation on pebble mounds that indicates either disturbance or droughty conditions is attributed to the activities of the mountain pocket gopher. Species prominent on mounds were cheatgrass, six-weeks fescue, ragweed, and hairy goldaster. Similar soil moisture conditions in mounds and in stony soil indicate that the two soils should have the same kind of vegetation if disturbance is not a factory. Evidence suggests that pocket gophers may be the casual factor for both the mounds and the subclimax vegetation on mounds.

Branson, F.A.; Miller, R.F.; McQueen, I.S.

1967

Geographic Distribution and Factors Affecting the Distribution of Salt Desert Shrubs in the United States

J. Range Management 20:287

Four previously published classifications of intermountain shrub vegetation and a new classification based on maximum salt tolerances and water relationships are presented. Maps show that the geographic range of salt desert shrub species far exceeds the distribution of mappable communities in which these shrubs are dominants. Species differ in their capacity to tolerate soil osmotic stress, but variable results from measurements of osmotic stress in 20 different plant communities indicate that additional factors must be important in determining species present in different habitats. Data obtained by the use of a new method of measuring total soil moisture stress in field samples show that the capacity of different species to remove soil moisture to different maximum stresses appears to determine the kinds of plants that occupy different habitats. Total soil moisture stresses for 14 plant communities sampled ranged from 19 to more than 90 bars.

Branson, F.A.; Miller, R.F.; McQueen

1969

Plant Communities and Associated Soil and Water Factors on Shale-Derived Soils in Northeastern Montana

Ecology 51:391-407

Sites on different strata of Bearpaw shale and on alluvium derived from the shale in a small basin in northeastern Montana supported strikingly different plant communities, including three Nuttall saltbush, three big sagebrush, two greasewood, one western wheatgrass, one blue grama, one silver sagebrush, one foxtail, one buckwheat, and a community of mixed shrubs. Several soil factors were measured, but only total soil-moisture stress and soil-moisture volume gave rational ordinations of the communities studied. Total soil-moisture stress at the average root depth ranged from a high of 96 bars for a Nuttall saltbush community to only 19 bars for a mixed shrub community. The Nuttall saltbush community was found on soils having a high soluble salt content, high soluble sodium percentages, high total soil-moisture stress, and low infiltration rates. Soils at the big sagebrush site had low soluble salt content, relatively high soluble sodium, and intermediate total soil-moisture stress values. The wettest site, subject to spring flooding, was occupied by western wheatgrass. Quantities of water evapotranspired from each habitat (calculated as maximum soil moisture minus minimum plus increments added to soils by summer storms) when related to precipitation provided approximations of runoff from, or run-in moisture for, each habitat.

Branson, F. A., Miller, Reuben F., McQueen, I. S.

1976

Moisture Relationships in Twelve Northern Desert Shrub Communities Near Grand Junction, Colorado

Ecology v.57 :1104-1124

Twelve northern desert shrub communities having the same macroclimate but differing habitats were studied. Arranged in order of decreasing production of live stems plus current growth, the communities were: (1) Sarcobatus vermiculatus (9,172 kg/ha), (2) Grayia spinosa (7,412 kg/ha), (3) Artemisia tridentata (5,474 kg/ha), (4) Chrysothamnus nauseosus (4,836 kg/ha), (5) Atriplex confertifolia (3,194 kg/ha), (6) Eurotia lanata (2,026 kg/ha), (7) Hilaria jamesii-Atriplex confertifolia (1,995 kg/ha), (8) Atriplex corrugata (1,949 kg/ha), (9) Chrysothamnus greenii filifolius (1,866 kg/ha), (10) Atriplex nuttallii (1,309 kg/ha), (11) Elymus salinus (865 kg/ha), and (12) Tetradymia spinosa (564 kg/ha). The communities were relatively simple in terms of plant composition; the dominants in many of them contribute > 90% of the plant cover. Seasonal patterns of both internal-plant stresses and soil-moisture stresses were measured. Both sets of values increased from late May until early September when increases in rainfall caused both to decrease. Minimum internal-plant stresses were similar for all species but maximum values differed greatly. Maximum plant-stress value ranged from 103 bars for A. nuttallii to only 40 bars for C. nauseosus. Internal-plant stresses were closely related to minimum soil-moisture stresses found within soil profiles at the time of sampling. The relationship was good for upland species but poor for species in moist habitats. Similar close relationships were found for internal-plant stress and quantities of moisture stored in soils. Correlation coefficients for internal-plant stress vs. wind and atmospheric stress were low and nonsignificant, but air temperature was significantly correlated with plant stress in several species. Evapotranspiration was significantly related to percent live cover (r=+.84**). Soil salinity at field-capacity valued ranged from > 16 bars to < 1 bar; only 5 of the 12 habitats had saline soils. The highest root mass (2,547 kg/ha) was in the C. nauseosus nauseosus soil--the lowest (569 kg/ha) in the A. corrugata soil. Efficiency of water use (plant growth per unit of water used) was lower for species occupying dry habitats than for those in moist habitats. Phenological observations showed that most species occupying moist habitats continued active growth for longer periods. A study of persistence of leaves showed 10% annual loss of leaves in A. corrugata. Ninety percent of leaves of this species were retained throughout the season whereas < 20% of marked leaves were retained by A.tridentata and A. nuttallii.

Bray, W. L.

1901

The Ecological Relations of the Vegetation of Western Texas

Botanical Gazette 32(2) :99-123, (3) :195-217, (4) :262-291

Includes a map of physiographical provinces and another of vegetation provinces of western Texas. Notes mesquite to be an indicator of the lower Sonoran zone and creosote-bush present around El Paso and in the trans-Pecos country.

Bray, W. L.

1906

Distribution and Adaptation of the Vegetation of Texas

University of Texas Bulletin 82, Scientific Series 10, 108 p.

Territory between 96th and 98th meridians is the zone of transition between mesophytic and xerophytic vegetation. At Austin, mixture is very evident: Grasslands - (1) semi-humid black-soil prairies 30-35", (2) semi-arid middle plains, (3) arid high plains below 20". High plains wast 101st meridian above 2000 feet, rainfall below 20 inches (grass not named). Desert vegetation - the sotol country desert in Texas is due to edaphic rather than climatic conditions. Lower Sonoran zone west of 101st meridian is desert. Sotol country dissected foothills with loose stony debris.

Brown, R.W.

1971

Distribution of Plant Communities in Southeastern Montana Badlands

Am. Midland Naturalist 85(2):458-477

This work represents the first attempt to quantitatively study the vegetation of the plant communities of southeastern Montana. The vegetation of each community was sampled using a modified form of the line-intercept method and soil samples were collected. The climate ranged from sub-humid to semi-arid. Abrupt changes in the vegetation were between stands and these appeared to correspond with abrupt soil and physiographic changes. There were five shrub-dominated and two tree-dominated communities. Substantial variations in soil and topographic characteristics occur within small areas leading to rather steep environmental gradients.

Bryan, K.

1928

Changes in Plant Associations by Change in Ground-Water Level

Ecology 9(4):474-478

Cites evidence for the existence of Phreatophytes, and notes changes in plant associations accompanying channel-cutting and lowered ground water tables. Historical reports are cited that indicate the Santa Cruz and San Pedro Rivers once contained many cienegas. Progressive changes in the vegetation led from bulrush, using surface water, through the grasses (Sacaton) and cottonwoods, using shallow groundwater, to the deep-rooted mesquite (Prosopis), using deep groundwater, following a lowering of the water table. The fundamental cause of arroyo cutting may have been due to change to a drier climate. If this is true, overgrazing is an accessory which wet the data at which cutting might begin.

Buffington, L.C.; Herbel, C.H.

1965

Vegetational Changes on a Semidesert Grassland Range from 1858 to 1963

Ecological Monographs, V.35, No.2, p. 140

Table of Contents

Extensive areas of the semidesert grassland of the Southwest are dominated by creosotebush (Larrea tridentata (DC) Coville), mesquite (Prosopis juliflora (Swartz) DC), and Tarbush (Flourensia cernua DC). Mesquite occurs on 93,000,000 acres; creosotebush is present on 46,500,000; and tarbush occurs on 13,250,000 acres (Platt 1959). Although the species are indigenous, they have invaded large areas in the past 100 yrs. Some areas invaded by tarbush still have a good understory of grass. However, loss of forage production occurs in early stages of mesquite invasion (Norris 1950). In creosotebush-dominated areas, forage production is negligible (Gardner 1951).

The productivity of the rangeland greatly influences the economy of the Southwest. Therefore, it is important for the rancher to conserve and, where necessary, improve the range resource. Some knowledge of original vegetation conditions is essential in properly evaluating the potential of various sites.

Much has been written about the semidesert grassland, including quotations from many early travelers. Some authors have based general assumptions on these quotations. However, the quotations are difficult to evaluate properly. In making their observations, many early travelers were influenced by the seasons and by their personal emotions. Furthermore, very few of the areas described by early travelers can actually be relocated for present-day comparisons.

This study aims to show the degree of encroachment of brush on the study area and also the nature of the invasion on various soil types. Vegetation surveys of 1858, 1915, 1928, and 1963 were compared. Factors possibly responsible for the changes in vegetation were examined. This study was conducted on the Jornada Experimental Range, which is 23 mi north of Las Cruces, New Mexico.

Campbell, C. J., Dick-Peddie, W. A.

1964

Comparison of the Phreatophyte Communities on the Rio Grande in New Mexico

Ecology v.45 (3) :492

Randomly spaced line intercepts were taken in 18 relatively mature phreatophyte communities on 300 miles of the Rio Grande in New Mexico. Samples of three stands in each of six geographical areas revealed no regularity in species present, percentages of cover, or height over the entire area. Vegetation of the southern and northern sectors was different. Highly significant differences in tamarisk (Tamarix pentandra) and screwbean (Prosopis pubescens) cover were found in plots within areas. The difference in cottonwood (Populus fremontii) cover within and between plots where cottonwood dominated was nonsignificant. No correlation could be found between pH, total soluble salts, and texture of the soil and dominant species of plants growing in the area. In general, no distinct breaks or ecotones occurred in the composition of the narrow band of river vegetation; it formed a continuum with gradual and almost imperceptible changes between dominant and subdominant species as one moved north or south. Postclimax vegetation has been altered or modified in many areas to produce quasi-permanent or disclimax vegetation. Five classes of phreatophyte vegetation were arbitrarily established, the lowest development consisting primarily of screwbean in the southern sector and the highest of dominant cottonwood above San Antonio, New Mexico. The introduction and escape of tamarisk and Russian-olive (Elaeagnus angustifolia) in the last 50 years have changed the successional stages and ultimate dominants of some communities.

Cannon, H.L.

1971

The Use of Plant Indicators in Ground Water Surveys, Geologic Mapping, and Mineral Prospecting

Taxon 20(2-3):227-256

The use of vegetation in interpreting geological phenomena is becoming an important tool in the search for ore deposits that are buried under thick soil cover or layers of unmineralized rock. Species assemblages and plant density are useful in mapping geologic strata of different chemical composition and reservoir capacity. Hidden ore deposits can be located through chemical analysis of plant tissue, by mapping the distribution of species, and by observing toxic effects caused by an excess of metals as well as signs of faulty nutrition or deranged metabolism in plants whose roots are in contact with ore. Plant indicators of ore deposits may be species that are adapted to living exclusively on rocks or soils that supply unusual amounts of a particular element, or they may be species of wide distribution that favor mineralized ground under certain local conditions because of a change in acidity or availability of major plant constituents. Plants that are not highly tolerant of metals in an ore assemblage may exhibit toxicity symptoms or be completely absent over ore. Geobotanical techniques of mapping indicator plant species and communities, combined with observation of changes in plant appearance can aid the geologist in prospecting for hidden ore deposits.

Cannon, W. A.

1916

Distribution of the Cacti With Especial Reference to the Role Played by the Root Response to Soil Temperature and Soil Moisture

American Naturalist 50 :435-442

Notes that cacti usually have very shallow root systems which are subject to the influence of high temperatures but are advantageous in collecting moisture from light rainfall, and that cacti usually occur where rains fall in the warm season.

Carter, W. T.; Cory, V. L.

1932

Soils of Trans-Pecos Texas and Some of Their Vegetative Relations

Texas Academy of Science, Transactions (Including Proceedings) 15 :19-32

A general description of soils and vegetation, including desert types, in western Texas.

Cary, M.

1911

A Biological Survey of Colorado

North American Fauna 33: 1-256

Includes brief but useful material on the vegetation of the upper Sonoran zone of western Colorado. Sagebrush and shadscale communities are described and discussed.

Cary, M.

1917

Life Zone Investigations in Wyoming

North American Fauna 42 :1-95

Includes a description of the Red Desert of western Wyoming and other information relating to the vegetation of the upper Sonoran zone of western Wyoming.

Chadwick, Howard W., Dalke, Paul D.
W
1965

Plant Succession on Dune Sands in Fremont County, Idaho

Ecology, v.46 (6) :765

Active sand dunes in Fremont County, Idaho, move northeastward at an approximate average rate of 3 m/year. Sand deposits, continuous in some areas for several kilometers, extend to windward from the dunes in the form of long ridges, parallel to the wind direction. Five successional vegetation stages, distinct as to dominant species, appear on the deposits as belts transverse to the direction of dune movement. Elymus flavascens and Psoralea lanceolata dominate the pioneer stage, which lasts up to about 30 years. The second stage, dominated by Chrysothamnus nauseosus with an understory of the two pioneer species, lasts for 10 to 70 years. Purshia tridentata then replaces much of the C. nauseosus to form a third stage lasting for about 50 to 70 years. Dominant species in the fourth stage are Artemisia tridentata, P. tridentata, and in many areas Prunus virginiana var. demissa. Very little A. tridentata is found after 700 to 900 years of stabilization, and the final and most extensive stage on deep sand is dominated by dense P. tridentata with clumps of P. virginiana var. demissa. Vegetation on old shallow deposits has characteristics of both that on deep sand and the Artemisia/bunchgrass type on the surrounding native soil. Fields that were plowed and abandoned in the early 1930's now support dense stands of Stipa comata.

The presence of dense shrub stands on dunes now topographically sheltered by the wind, but not on migrating dunes, indicates that establishment of a species on sand depends on relative site stability rather than on soil nutrient buildup caused by previous vegetation. Deep sand holds moisture available to plants throughout the dry part of the growing season while the native soil does not, which probably accounts for the greater shrub density and vigor on sand.

Chamrad, Albert D., Box, Thadis W.

1965

Drought-Associated Mortality of Range Grasses in South Texas

Ecology, v.46 (6) :780

The effects of a 2-year drought on native grasses in South Texas were investigated on the Welder Wildlife Foundation Research Area during the summer of 1963. The percentage mortality on Victory clay, Nueces fine sand, and Miguel fine sandy loam was determined for seacoast bluestem (Andropogon scoparius Michx. var. littoralis (Nash) Hitch.), silver bluestem (Andropogon saccharoides Swartz var. longipaniculata Gould), fully panicum (Panicum filipes, Scribn.), buffalograss (Buchloe dectyloides (Nutt.) Engelm.), Pan American balsamscale (Elyonurus tripsacoides Humb. and Bonpl.), and brownseed paspalum (Paspalum plicatulum Michx.). Mortality ranged from an average low of 34.7% for silver bluestem on Victoria clay to an average high of 76.8% for seacoast bluestem on Miguel fine sandy loam. Differences in percentage mortality between soils and between species on given soil types were highly significant. Mortality among individual clones ranged from 0% to 100%. In some instances a significant positive correlation existed between size of grass clones and percentage mortality. As diameter of clones increased, percentage mortality increased.

Chapman, V. J.

1942

The New Perspective in the Halophytes

Quarterly Review of Biology 17(4) :291-311, BA 17(7)17890

A summary of recent contributions relating to plants which attain optimum development in salt concentrations greater than 0.5 per cent. Discusses the effect of the salts on succulence and physiological processes.

Charley, James L., West, Neil E.

1975

Plant-Induced Soil Chemical Patterns in Some Shrub-Dominated Semi-Desert Ecosystems of Utah

J. Ecology (63) :945

While it has long been known that localization of litter fall can lead to significant modification of soil chemistry beneath trees and shrub species of arid and semi-arid areas (Roberts 1950; Fireman & Hayward 1952; Paulsen 1953), little has been done to define the detailed structure of these chemical alterations or their significance in terms of general ecosystem function. In recent years, however, there has been a renewal of interest in such plant-induced soil changes (Ebersohn & Lucas 1965; Rickard 1965a, b; Rickard & Keogh 1968; Jessup 1969; Garcia-Moya & McKell 1970; Charley 1972; Sharma & Tongway 1973; Tiedemann & Klemmedson 1973a, b) and a beginning has been made on the study of such distributional mosaics in relation to nutrient turnover.

Early studies were concerned with ions associated with salinity, whereas current emphasis is more towards the configuration of the soil organic regime, particularly the nitrogen pool. Research in saltbush communities of semi-arid Australia (Charley & Cowling 1978; Cowling 1969) has established that there are marked horizontal and vertical gradients in total soil nitrogen, available phosphorus, organic carbon and nitrogen mineralization capacity. Gradients can be so steep that to be unaware of them, or to ignore them in soil sampling programmes, could result in serious errors in estimations of either the nutrient capital or its turnover in the ecosystem (Charley 1972).

When the present study was initiated, no similar work on nutrient patterning had been undertaken in shrub-dominated rangelands of the western U.S.A. but it was apparent from the data of Garcia-Moya & McKell (1970) that some parallels with Australian experience could be expected. Accordingly, a broad survey was undertaken to test the applicability of previous findings and to provide a body of preliminary information on soil nitrogen, carbon and phosphorus levels in support of other research concerned with nutrient cycling.

While the results which follow include comparisons of degree of pattern development for a number of soil chemical characteristics, principal emphasis is on the level and organization of the organic nitrogen reservoir in terms of its profile distribution and horizontal variability about individual semi-desert shrubs.

Clark, L.D.; West, M.E.

1971

Further Studies of Eurotia lanata Germination in Response to Salinity

Southwestern Naturalist 15(3):371-375

An effort was made to determine whether winterfat (E. lanata) shows ecotypic variations within one valley. Seeds were collected at three sites in Duplew Valley, Utah: a pure bottom stand, a mixed bottom stand, and mixed bench stand. This study employed a random block design with four replications at four levels of sodium chloride, sodium carbonate, calcium chlorine, and potassium sulfate (0.0, 0.5, 1.0, and 2.0 percent solutions in 1.5 percent agar). All germination percentages decreased as salt level increased but differed significantly between salt levels and between seed sources for three of the salts. Chloride salts caused greater germination depression than sulfate salts. Annual germination differences are probably related to differences in seed source, production time, and climatic differences. Nevertheless, the data suggests ecotypic differences between seeds from sites less than one mile apart.

Clements, F. E.

1920

Plant Indicators: The Relation of Plant Communities to Process and Practice

Carnegie Institution of Washington, Publication 290 :1-388

A detailed discussion of climax formations of western North America, including extensive descriptions and illustrations of desert vegetation. It is valuable for its description of plant communities; however, many included concepts on successional processes and climax communities have been altered in recent years.

Cline, J.F.; Uresk, D.W.; Rickard, W.H.

1977

Comparison of Soil Water Used by a Sagebrush-Bunchgrass and a Cheatgrass Community

J. Range Management 30(3):199

Two contrasting plant communities occur on the Arid Lands Ecology (ALE) Reserve in south-central Washington, one dominated by a mixture of sagebrush and bluebunch wheatgrass and the other by a nearly pure stand of cheatgrass. At the beginning of the spring growing season in 1974, a year of above-average precipitation, both communities had about the same amount of soil water stored in the first 18 dm of the soil profile. During the growing season, the quantity of soil water used by the sagebrush-bunchgrass and cheatgrass communities was 15 and 8 cm, respectively. The difference in soil water used by the two communities is attributed to a deeper root system and a longer growing period by plants of the sagebrush-bunchgrass community.

Cloudsley-Thompson, J. L., ed.

1954

Biology of Deserts; Proceedings of a Symposium on the Biology of Hot and Cold Deserts, Organized by the Institute of Biology

Stechert-Hafner, Inc., New York, 244 p.

This volume contains the papers presented at the symposium held by the Royal Institute of Biology; the symposium covered many different phases of the biology of deserts, including plant ecology.

Clover, E. U.

1938

The Cactaceae of Southern Utah

Torrey Botanical Club, Bulletin 65(6) :397-412, BA 12(7)12292

Report of a field survey in southern Utah, mostly in the lower Sonoran zone in the vicinity of St. George. Discusses the ranges and distributions of many species.

Cokey, I. W.

1951

Flora of the Charleston Mountains, Clark County, Nevada

University of California, Publications in Botany 24 :1-274
BA 26(4)9508

Discusses the history of botanical exploration in the area geology, and plant associations; includes keys to the plants occurring in the area and detailed distribution records.

Cole, N. H. Ayodele

1967

Comparative Physiological Ecology of the Genus Eriogonum in the Santa Monica Mountains, Southern California

Ecological Monographs v.37 (1) :1-24

Table of Contents

The genus Eriogonum Michx., a North American member of the Polygonaceae, has its greatest concentration of species in the drier parts of the western United States and northern Mexico. The species offer a dramatic example of adaptive ratiation in the diverse growth forms they assume and the varied habitats they occupy. In California alone there are over 75 species, both annuals and perennials, which occur from coastal bluffs to alpine tundra and in the most severe deserts.

67A

On the Santa Monica Mountains of southern California, there are seven closely related species of Eriogonum all of which belong to the subgenus, Oregonium (Munz & Keck 1959). This mountain range offers a variety of habitats with different climates where adaptive ratiation is apparent in Eriogonum, although on a smaller scale than that which is evident in the genus as a whole. Some of the species occupy very limited habitats; others are seemingly habitat indifferent.

Torrey and Gray monographed the genus Eriogonum in 1870. Then, in 1936, Susan Stokes published a revision emphasizing geographical distribution and probably paleohistory of the group. She divided the genus into four subgenera corresponding to the four main geographical areas of distribution of the genus during the postglacial era. Stebbins (1942) investigated the cytotaxonomy of the polymorphic Erigonum fasciculatum to show evolutionary trends in the formation of species.

The physiological approach to the problem of plant distribution was pioneered by Turesson (1922) in Sweden where he was concerned with the ecological, morphological and physiological differentiation of populations of various species under uniform environmental conditions. In California, Clausen, Keck & Heisey (1940) investigated the nature of genecological differentiation between populations cultivated under uniform and reciprocal environments. Similar experimental approaches have been used by various workers with a view to elucidating factors controlling the distribution of species factors controlling the distribution of species (Mooney & Billings 1961; Bjorkman, Florell & Holmgren 1960; McMillan 1955; Bradshaw 1959) or as a tool in studying the biosystematics and evolution of plant species (Gregor 1944; Barber 1956; Sinkaja 1958; Herbard 1977; Bocher 1963).

The above investigations concentrated on population differentiation within a single species. The close relationships between the Santa Monica Mountains species of Eriogonum and their diverse distributional patterns offer material to extend genecological investigations to the generic level. In this study, comparisons are made not only between populations of a given species occurring in different habitats, but between populations of different species in the same habitat.

Collins, B.

1976

Range Vegetation and Mimi Mounds in North Texas

J. Range Management 28(3):209

Mima mounds are found in many areas west of the Mississippi River. The polygenetic origin of mounds in different areas is commonly accepted. The formation of these mounds in the Blackland Prairie may be associated with past climatic changes in the area, and resultant erosion and vegetational changes.

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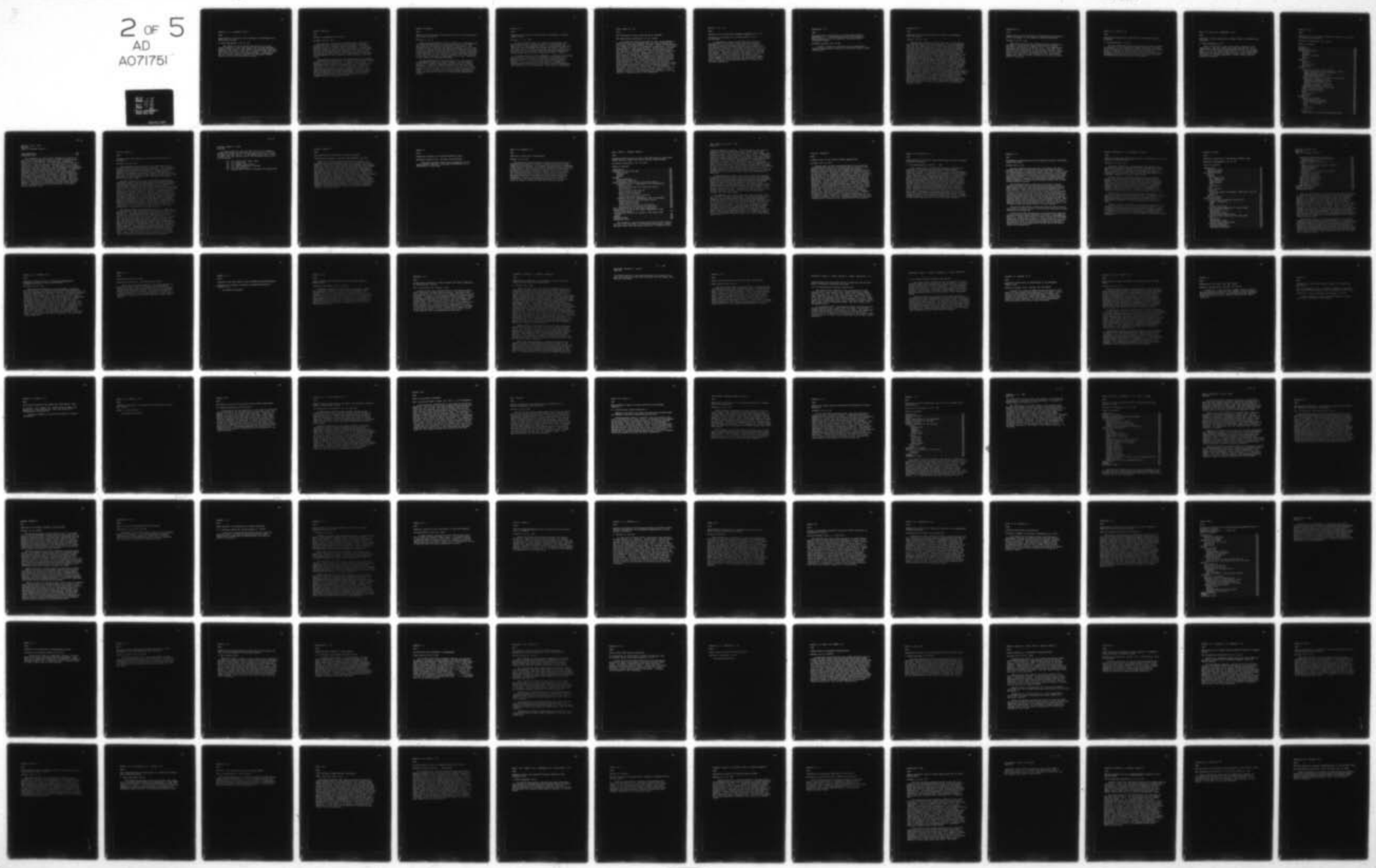

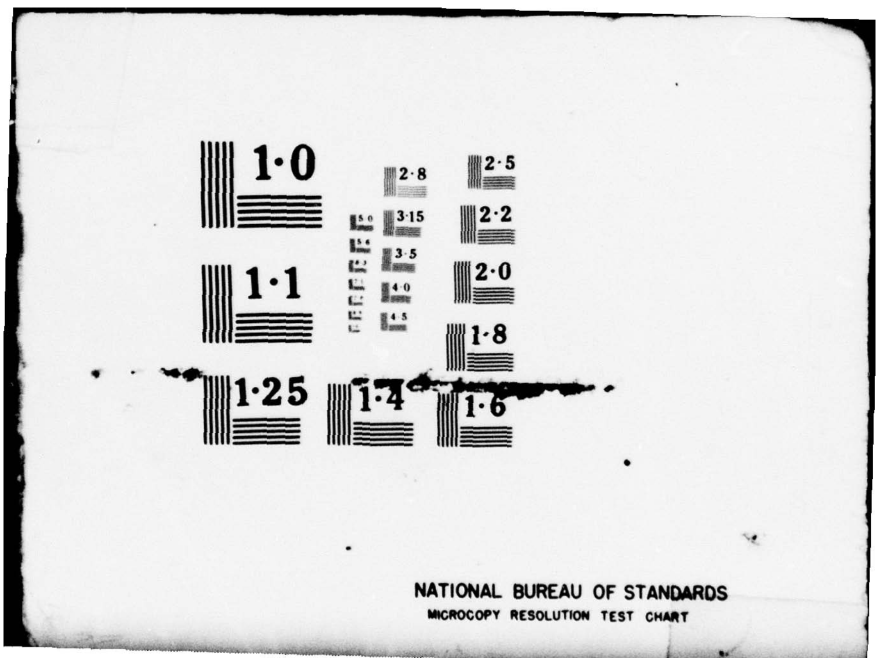
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NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

Conard, E. C.; Youngman, Vern E.

1965

Soil Moisture Conditions Under Pastures of Cool-Season and Warm-Season Grasses

J. Range Management v.18 (2) :74

The season of active growth and water use by warm-season grasses is about five months, May through September, compared with seven to eight months for cool-season grasses. There was less water in the soil in midspring each year under cool-season than under warm-season grasses. Consequently, the cool-season pastures suffered from midsummer drought more often than did warm-season pastures.

Cooper, Charles F.

1961

Pattern in Ponderosa Pine Forests

Ecology v.42 (3) :493

The ponderosa pine (Pinus ponderosa Laws.) forests of northern Arizona, although relatively simple in species composition, have a complex spatial structure. At least 4 distinct scales of pattern can be identified: a large scale pattern induced by local variations in topography and soils; a mosaic of even-aged groups, averaging 1/5 acre in size; variability in stand density within an even-aged group; and the arrangement of the individual trees making up a uniform stand.

The ponderosa pine forests of southwestern United States are particularly suitable for the study of spatial and temporal patterns in plant communities. In most of the region, ponderosa pine is not only the dominant, it is virtually the only tree in the forest. Relatively few age classes are represented, for only in the occasional years when a good seed crop and favorable moisture conditions coincide can abundant reproduction become established. Several features of the environment and of the life history of the species reinforce the tendency toward pattern formation that is perhaps normal in any plant community.

Cooper, William S.

1926

Vegetational Development Upon Alluvial Fans in the Vicinity of Palo Alto, California

Ecology v.7 (1) :1

The study here presented had its origin in a distributional and causal investigation of the superb forest of oak which characterizes the environs of Palo Alto, California. The construction of a detailed map proved necessary, in the course of which it became evident that the native vegetation over much of the area had been seriously modified by cultural operations. A thorough search of the literature, and the personal testimony of old residents of the district, combined with field observations, made it possible to reconstruct the original vegetation of the region in a satisfactory manner.

It soon appeared that the oak forest is a late stage in a successional sequence of great interest, and the dynamic phases of the problem thereupon assumed the place of first importance. Moreover, certain features came to light which were difficult to reconcile with current systems of ecological thought. The excuse for this rather minutely detailed local study, if such be needed, lies in its possible helpfulness toward the solution of some of the more general problems of ecology.

Cottle, H. J.

1932

Vegetation on North and South Slopes of Mountains in Southwestern Texas

Ecology v.13 (2) :121

As one travels through the mountains of Brewster, Jeff Davis, and Presidio counties in what is known as the Big Bend Country of southwestern Texas, it is noticeable that the north and south exposures are markedly different. Most of the trees and tall grasses grow along the north slopes of the mountains, while the south slopes are sparsely covered with short grasses and other xeric vegetation (figs. 1 and 2).

In a previous paper, the vegetation, as well as the environmental factors under which it develops on the "flats" or mountain valleys, has been rather fully described, but no description was given of the vegetation of the mountain slopes. It is the purpose of this study to consider the environmental factors of north and south mountain slopes and their relation to the development of the cover of vegetation.

Dale, Edward E., Jr.

1959

The Grasslands of Platt National Park, Oklahoma

The Southwestern Naturalist v.4 (2) :45-60

An ecological analysis was made in 1956 of grasslands in Platt National Park, Oklahoma that had been protected from disturbance for approximately 26 years. These grasslands were of 3 types on the basis of vegetation composition. The Andropogon scoparius type occupies mesic, upland sites with well drained soils. Andropogon scoparius and Sporobolus asper var. pilosus are the dominants. Forbs are mostly perennials typical of true prairie. Vegetation of this type is in a late stage of succession approaching a true prairie climax. The Bouteloua hirsuta type occupies xeric upland sites with thin, dry soils. Principal dominants are Bouteloua hirsuta and Aristida purpurea. Forbs are mostly annuals and short-lived perennials. Relict preclimax sites are occupied principally by B. hirsuta. Sites occupied primarily by other short grasses and weedy forbs are subclimaxes probably caused by severe overgrazing in years past. The Muhlenbergia Reverchoni type occupies poorly drained, thin soils that are saturated in spring and very dry in late summer. It is a subsere community in which Muhlenbergia Reverchoni, the only dominant, comprises most of the vegetation.

Dalton, P. D., Jr.

1962

Ecology of the Creosotebush *Larrea Tridentata* (DC.) Cov.

University of Arizona (Ph.D. Dissertation), 170 p., BA 39(2)4552

A comprehensive study, which notes the bicentric distribution of the genus in North and South America. Includes a map of the general distribution of *Larrea* in the southern deserts of North America, and another of its distribution in Arizona. Discusses various communities in which it is found, and notes periods of growth, flowering, and seeding. Anatomical studies show ways water loss may be reduced. Notes that extracts from *Larrea* leaves and roots did not inhabit germination and early growth of either *Larrea* or certain grasses, but that mature *Larrea* plants absorb available soil moisture remarkably well; the even spacing of creosotebush appears to result from moisture competition.

Daubenmire, R. F.

1940

Contributions to the Ecology of the Big Bend Area of Washington, II: Indicator Significance of the Natural Plant Communities in the Region of the Grand Coulee Irrigation Project

Northwest Science 14(1) :8-10

A useful listing of indicators of soil conditions varrying from harmful salinity and high water table to deep fertile soil.

Daubenmire, R.

1953

Nutrient Content of Leaf Litter of Trees in the Northern Rocky Mountains

Ecology v.34 (4) :786

Considerable interest has been directed to the study of the chemical composition of tree leaves. It was discovered long ago that species differ in their abilities to extract nutrients from the same kind of soil, and that the minerals are not similarily disposed in the tissues, with a result that their litter varies considerably in composition. The silviculturist sometimes finds it desirable to maintain in a mixed stand certain trees that produce low-value wood, only because they are useful in maintaining soil fertility for associated valuable species. The speed of rehabilitation of waste-lands and eroded areas varies with the species used in reforestation. Game management must often take into account the nutrient content of foliage available for browsing. Some analyses have been made in the hope that a reliable method of evaluating soil fertility could be discovered. Although nutrient content often appears unrelated to soil fertility as indicated by chemical analyses of soil or by vigor of growth, special correlations of local significance have found with sufficient frequency that this relationship always deserves study. In any inquiry into why trees grow where they do, the varied influences of the different species must be given careful consideration, for small initial differences in environment may cause differences in the pioneer vegetation, then the contrasted floras add so much more difference as to obscure the primary factor that caused initial divergence (Chandler 1939).

Daubenmire, R.

1972

Annual Cycles of Soil Moisture and Temperature as Related to Grass Development in the Steppe of Eastern Washington

Ecology v.53 (3) :419

The annual cycle of soil moisture use and recharge was followed in eight climax steppe communities by making gravimetric analyses to a depth of 1 m. Soil temperatures were measured at depths of 50 and 100 cm. The data were related to the phenologies of the dominant grasses. Differences in soil moisture and temperature seem to contribute more toward explaining the distributions of these steppe communities than do chemical content of the soils or their profile characters.

Dealy, J.E.; Geist, J.M.

1978

Conflicting Vegetational Indicators on Some Central Oregon Scablands

J. Range Management 31:56-59

Two soil-vegetation sites were studied in central Oregon to determine why two conflicting plant indicators (antelope bitterbrush and low sagebrush) occurred on apparently uniform sites. Investigation showed that bitterbrush was not a reliable indicator of site conditions in the two study areas. Landscapes that appeared to be uniform were actually highly variable because of internal soil differences.

Dee, R.F.; Box, T.W.; Robertson, E.Jr.

1966

Influence of Grass Vegetation on Water Intake of Pullman Silty Clay Loam

J. Range Management 19:77

Water infiltration rates varied under different plant communities. The soil under blue grama absorbed 8.4 in. of water in a two-hour period compared with 5.6 in. for windmill grass, 3.8 in. for annual weeds, and 2.1 in. for buffalograss. High positive correlations existed between water intake and the amount of standing vegetation, litter, and litter and vegetation combined.

Despain, Don G.

1973

Vegetation of the Big Horn Mountains, Wyoming, in Relation to Substrate and Climate

Ecological Monographs v.48 :329-355

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Despain, Don G., 1973
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The vegetation of the Big Horn Mountains is typical of the Central Rocky Mountain region; a lower Juniperus osteoperma zone is followed by Pinus ponderosa, Pseudotsuga menziesii, Pinus contorta, and Picea engelmannii-Abies lasiocarpa zones. Rock or geologic substrate type has a strong influence on forest vegetation. On sedimentary areas forests cover less than 50% of the area and are composed of Pseudotsuga menziesii or Picea engelmannii-Abies lasiocarpa. On granitic substrates forests cover over 80% of the surface and are composed chiefly of Pinus contorta with Picea engelmannii-Abies lasiocarpa at higher elevations. Populus tremuloides is present but unimportant as a vegetation type. Most of the rainfall comes during March, April, and May; precipitation is less than 30 mm per month during summer. Thus soil-water relationships are important in determining vegetation pattern. Precipitation comes from the east, which allows forest vegetation to reach lower elevations on the east than on the west slope.

Dittmer, Howard J.

1959

A Study of the Root Systems of Certain Sand Dune Plants in New Mexico.

Ecology v.40 (2) :265

Arid and semi-arid regions are very favorable areas in which to study the rooting habits of plants. This is partly because the environmental features are severe, so that the responses on the part of the plants are correspondingly effective for survival and partly because the sparse distribution of the plants permits ready erosion of the soil by wind and water to permit access to the wide-spread and deeply penetrating root systems.

The dual functions of roots in providing anchorage and absorptive organs is well represented in xerophytic plants by the differentiation of the root system, in its later stages, into separate anchoring and absorptive organs or both. Cannon (1911) observed the root systems of different perennials growing in the vicinity of the Desert Laboratory, Arizona, and noted that they were "extremely variable as regards depth of penetration, lateral extent, and other characteristics, and that no one type of root can be said to be the prevalent one." Similarly Helmers et al. (1955) reported marked differences in "depth of penetration, lateral spread, number, and size of main and branch roots," for different species of chaparral plants in southern California. Woods (1957) attributed the shallow root systems of several woody species growing on the sand hills of the southeastern Coastal Plain as due to a combination of light rainfall, low fertility, and higher temperatures in the upper few inches of soil.

The present paper includes descriptions of a number of plants inhabiting the sand dunes of a section in north central New Mexico. The dunes extend for about 20 miles along an intermittent stream which carries considerable water in spring from melting mountain snow but during the rest of the year it has very little or no surface water flowing through it. The dune area most intensively studied is about one mile away from the river and is characterized by abundantly shifting sand over a considerable area. Most of the work was done on the dunes in the vicinity of the Santa Ana and Zia Indian Pueblos. The elevation is about 6000 feet and in the more stable soil around the dune area one-seeded juniper, Juniperus monosperma (Engelm.) Sarg. is the most prominent plant. In the shifting sands (Fig. 1) Ipomoea leptophylla Torr., Dalea scoparia A. Gray, and Chrysothamnus nauseosus (Pall.) Britton are the most conspicuous large plants.

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In some places the sand has been blown off to expose a hardpan of caliche but for the most part the sand is formed in dunes many feet thick. In one exposed area, over 12 feet in depth, the soil was made up of the following strata from top to bottom:

(1) 3'6" loose sand, upper layer
(2) 2'6" sandy clay
(3) 1'2" washed river gravel
(4) 1'6" hard packed clay (Caliche)
(5) 4'2" coarse gravel
(6) another gravel layer, thickness not ascertained

Dittmer, Howard J.

1969

Characteristics of the Roots of Some Xerophytes

Physiological Systems in Semiarid Environments :231-238

There are 4 major types of desert root systems: (1) storage roots which have relatively thick, water-retentive epidermal layers (2) long tap roots not enlarged into storage roots (3) relatively large lateral roots confined to the upper few inches of soil (4) shallow fibrous roots characteristic of grasses. Penetration depths, lateral root development and root densities varies among species and are functions of genetic potential and environmental conditions. Nearly all desert root systems have mycorrhizal associations which decrease with soil dryness. Bacterial nodules on leguminous plant roots are also less abundant in arid soils. Drought resistance is mainly due to anatomical adaptations. Desert plants have a higher percentage of root xylem in relation to their diameter than more mesic plants. This results in slower water movement and greater water storage. Additionally, special cortical cells and resinous substances increase bound water content. (Casey-Arizona)

Dixon, H.

1935

Ecological Studies on the High Plateaus of Utah

Botanical Gazette 97(2) :272-320, BA 10(8)17842

Discusses southern desert plant communities of the lower Sonoran territory, including rock deserts at an televation of 5,000 feet.

Dodd, J. D., Coupland, R. T.

1966

Vegetation of Saline Areas in Saskatchewan

Ecology, v.47 (6) :958

The vegetation of uncultivated saline soils in the grassland zone of Saskatchewan was examined at 270 sites: in each from two to eight plant communities were recognized. Saline Gleysol soil surrounding the permanently flooded center of depressions is occupied by amphibious species, particularly Scirpus paludosus. With decreasing salinity from the wet center to the dry margin of depressions a sequence of vegetation types occurs which are characterized by dominance of Salicornia rubra on Saline Gleyed Regosol soil, Triglochin maritima, Puccinellia airoides, Distlichlis stricta, and Hordeum jubatum on Saline Meadow soil, and Sarcobatus vermiculatus, Muhlenbergia richardsonis, and Agropyron spp. on Saline Calcareous Chernozem soil. Saline Rego Chernozem soil occupies the transition to upland and supports a mixture of upland and salt-tolerant species.

Drew, James V., Shanks, Royal E.

1965

Landscape Relationships of Soils and Vegetation in the Forest-Tundra Ecotone, Upper Firth River Valley, Alaska-Canada

Ecological Monographs v.35 (3) :285

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The transition region between the Boreal Conifer Forest and the Tundra has been of considerable ecological interest although relatively few points along its circumpolar extent

have been studied in detail. In North America, the work of Lindsey (1952) near Great Bear Lake, Clarke (1940) near Great Slave Lake, Marr (1948) on the east coast of Hudson Bay, Johansen (1919) in eastern Canada, Hustich (1949) in Labrador, and Griggs (1934) at the edge of the boreal forest and maritime tundra in western Alaska have contributed to the vegetational knowledge of the ecotone. Essentially no information is available, however, on the characteristics of soils in the forest-tundra region of North America, and most schematic soil maps include these soils in the general Tundra group or refer to them as "soils of the forest-tundra transition." The purpose of this paper is to describe the vegetation and soils in a northern extension of the forest-tundra ecotone in the factors controlling the pattern of tundra and forest vegetation in this area.

In western North America, outliers of tree-form conifers reach their poleward limits along an irregular line extending northwest from the southern edge of Hudson Bay to the Mackenzie River Delta, and west along the south slopes of the Brooks Range in northern Yukon and Alaska to the Chukchi Sea (Hustich 1953). Picea and Larix are the most important tree-form genera at these northern limits with white spruce (Picea glauca) extending beyond black spruce (Picea mariana) across western Canada and Alaska. Beyond these spruce limits, poplar, willow, and birch, often in scrub form, may occur along streams well into the tundra.

As a general rule, spruce does not occur in Alaska within 100 to 300 mi of the Arctic Ocean. A notable exception occurs near the Canada-Alaska border, where white spruce extends northward from the valleys of the Porcupine and Old Crow Rivers to the headwaters of the Firth River in Alaska, and down the Firth valley into Canada to within 8 mi of the Arctic coast (Collins & Sumner 1953). This northern extension of spruce into the tundra seemed a desirable portion of the ecotone in which to study the interrelations of vegetation, soils, and topography. Consequently, during the summers of 1958 and 1959, field studies were conducted in the Firth River Basin on the Alaska-Canada boundary about 70 mi south of the Arctic Ocean (Fig. 1).

Driscoll, Richard S.

1964

A Relict Area in the Central Oregon Juniper Zone

Ecology v.45 (1) :345

Vegetational and soil characteristics of two relatively undisturbed associations on a semi-isolated plateau in the central Oregon juniper zone were studied and related. Agropyron spicatum was the most abundant herbaceous perennial in both entities. Artemisia tridentata was specific to the Juniperus/Artemisia/Agropyron association. Purshia tridentata was specific to the Juniperus/Purshia/Agropyron association. The specificity of these species was related to the way soil characteristics affected the soil water regime and rooting resistance. Purshia tridentata occurred on coarse-textured stony soils overlying cracked bedrock. Artemisia tridentata occurred on finer textured nonstony soils with dense, clayey subsoils. Other differences in floristics, soils, and soil-factor effects between the two units were sufficiently great to warrant classification of the entities as individual ecosystems. The annual Bromus tectorum was a conspicuous part of the vegetational component of both units. Juniperus occidentalis was not abundant in either association. It occurred in small clumps or as individual trees unevenly distributed throughout the area. Wildfires appeared to have been a major factor controlling the distribution of the species.

Dwyer, D.D.; Aguirre V., E.

1978

Plants Emerging from Soils Under Three Range Condition Classes of Desert Grassland

J. of Range Management 31(3):2 May

This research was conducted to determine emergence of seedlings from surface soil collected on black grama (Bouteloua eriopoda) grassland sites in good, fair, and poor condition classes. The species that emerged and their numbers were compared to the species actually found on the field locations. The following conclusions were drawn: (1)The fair condition site had more seedlings emerge than the other two and of these seedlings by far the most were grasses; (2)Mesa dropseed (Sporobolus flexuosus) was the most abundant grass species emerging from collected soil for all three condition classes, but it was much more abundant from fair condition soil; (3)Though black grama dominated the good condition range, emergence of black grama seedlings in the greenhouse from collected soil was much below expectations; (4)More plant species occurred in the field than emerged from collected soils; (5)Secondary successional patterns cannot be predicted accurately from techniques used in this study; (6)Mesa dropseed appears to be a key mid-successional species, filling a broad niche from low good to low fair range condition.

Dyrness, C. T.

1966

Soil-Vegetation Relationships within the Ponderosa Pine Type in the Central Oregon Pumice Region

Ecology v.47 (1) :122

Six plant communities occurring within the ponderosa pine (Pinus ponderosa) and white fir (Abies concolor) zones were identified east of the Cascade Mountains in southcentral Oregon. These units , listed in order of increasing effective moisture and increasing elevation, are as follows: (1) Pinus ponderosa/Purshia tridentata, (2) Pinus ponderosa/Purshia tridentata/Festuca idahoensis, (3) Pinus ponderosa/Purshia tridentata-Arctostaphylos parryana var. pinetorum, (4) Pinus ponderosa Ceanothus velutinus-Purshia tridentata, (5) Pinus ponderosa/Ceanothus velutinus, and (6) Abies concolor/Ceanothus velutinus.

The Pinus/Purshia/Festuca association is restricted to areas of Shanahan coarse sandy loam, while the remaining five units all occur on Lapine loamy coarse sand. Both series are Regosols developed on aeolian pumice deposits. Lapine profile characteristics influencing plant root distribution, such as thickness of the gravelly C1 horizon and amount of mixing of C2 material with the buried soil, showed some apparent correlations with plant communities. The Lapine soil under the Pinus/Purshia and Pinus/Ceanothus-Purshia communities had thickest C1 horizons and the smallest amounts of mixing in the C2. The soil associated with the Pinus/Ceanothus community had the thinnest C1 and a well-mixed C2 horizon. Roots were generally well distributed throughout the C2 horizon in the latter community, whereas in soils possessing a thick C1 and little mixing in the C2 roots are restricted largely to the A1, AC, and D horizons.

Soil-moisture measurements indicated that depth and time of onset of soil drought are important factors in controlling the distribution of plant communities in the study area.

The A1 horizon under Pinus/Ceanothus and Abies/Ceanothus communities contained appreciably greater quantities of available P, exchangeable Ca, and total N. Organic matter content of Lapine A1 horizon was considerably higher under the more mesic communities. Carbon-nitrogen ratios of Lapine and Shanaham A1 and Ac horizons were not correlated with plant groupings. C/N values were found to be very much higher than those encountered in surface horizons of zonal forested soils, probably due to slow rates of organic matter decomposition,

Eckert, Richard E., Jr., Kinsinger, Floyd E.

1960

Effects of Halogeton Glomeratus Leachate on Chemical and Physical Characteristics of Soils

Ecology v.41 (4) :764

Livestock grazing and attempted dry-land farming have depleted many rangelands and left others denuded of desirable perennial vegetation. Halogeton glomeratus (M. Bieb) C. A. Mey., a poisonous, annual weed, has invaded some depleted rangelands in the Western United States and now occupies vast acreages, frequently in dense, pure stands.

On some areas of former salt-desert types in eastern Nevada the entire plant cover consists of halogeton (Fig. 1). Whether these areas were denuded originally by overgrazing, farming, insects, or other factors is not known. Abandoned town sites support dense stands of halogeton. Experimental seedings made in halogeton-infested areas generally have failed. Even more striking is the lack of reinvasion by adjacent native species. The soil-plant relations in these halogeton stands are complex and have received little study.

Soil salinity and low precipitation restrict water availability to plants in the salt-desert type. If halogeton imparts additional salts to the soil surface, the chemical and physical characteristics of the soil may be changed to impair germination and growth of desirable species as well as halogeton.

Conservationists have shown an increasing interest in the vegetation and soils of the salt-desert-shrub type and a desire to improve forage production from Gray Desert soils. Since halogeton has invaded soils of this type, it seemed desirable to determine the effects of halogeton on the chemical and physical characteristics of 3 soils supporting salt-desert-shrub vegetation.

Ellison, Lincoln

1954

Subalpine Vegetation of the Wasatch Plateau, Utah

Ecological Monographs v.24 (2) :89

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Like all mountainous land of the West, the Wasatch Plateau in central Utah is vitally important to people of adjacent valleys. It furnishes their drinking water, the irrigation water on which nearly all their agriculture and industry depends, and summer forage for many of their livestock, as well as timber for local use, opportunities for outdoor recreation, and a habitat for wildlife. As surely as a canyon from the plateau opens upon the valley floor, so surely will one find a farm, a village, or a town. Each of these small islands of civilization is nourished, as by a silver umbilical thread, from snows that accumulate in the nearby highlands. If it were not for the higherlying, more humid, plateau the arid lowlands would never have been settled, and the flourishing and distinctive communities that the traveler passes through today would not exist.

The subalpine zone of the Wasatch Plateau is of special interest to the ecologist not only because of its bearing on human geography, but because the first studies of the influence of range vegetation on erosion and floods were made here. Forty years ago experiments were begun by the Intermountain Forest and Range Experiment Station which first clearly demonstrated that herbaceous vegetation, and not forest cover alone, had a profound effect on the infiltration and yield of water from torrential storms.

Evans, G. R., Tisdale, E. W.

1972

Ecological Characteristics of Aristida Longiseta and Agropyron Spicatum in West-Central Idaho

Ecology v.53 (1) :137

Germination requirements, root development, phenology, and the effects of moisture-saturated soils were studied in Aristida longiseta and Agropyron spicatum. Agropyron germinated well at temperatures of 20°-22°C, but Aristida showed little response until temperatures were increased to 40°C. Prior stratification at 0°C had no appreciable effect on germination of either species. Rapid primary root elongation enabled Aristida to establish itself in droughty habitats, but saturated soils strongly inhibited its growth. In the field A. longiseta starts growth late in the spring, develops at a rapid rate, and flowers 10 days later than A. spicatum. The seed of Aristida matures slowly and is shed in September. Fall regrowth, which occurrs normally in A. spicatum, is rare in A. Longiseta. The hypothesis is developed that excessive grazing has so reduced the abundance of A. spicatum that A. longiseta has been able to replace it and form long-lived communities.

Evans, P. A.

1926

An Ecological Study in Utah

Botanical Gazette 82(3) :253-285, BA 2(6-8)9136

The region described comprises the greater portion of Salt Lake County, Utah, and includes the narrow strip of the Great Basin from the Great Salt Lake to the western foothills of the Wasatch Range. The soil on the west side of the Jordan River is alkaline and therefore covered by a sparse growth of alkali-tolerant plants; the soil east of the river is higher, well drained, and mostly under cultivation.

Eymann, J. L.

1953

A Study of the Sand Dunes in the Colorado and Mojave Deserts

University of Southern California (unpublished Master's thesis), 91 p.

No abstract available.

Fautin, R. W.

1946

Biotic Communities of the Northern Desert Shrub Biome in Western Utah

Ecological Monographs 16(4) :251-310

Discusses sagebrush and shadscale communities. Notes that sagebrush communities occur along the windward base of mountains or in valleys where the precipitation is greater, or the soil is deep, more permeable, and relatively salt-free; and that shadscale and closely related communities occur in more xeric areas where the soil is often heavily impregnated with mineral salts. Temperature conditions for both communities are similar. The average precipitation is nearly 5 inches for sagebrush, compared to about 8 inches for shadscale areas.

Ferguson, C.W.

1950

An Ecological Analysis of Lower Sonoran Zone Relic Vegetation in South-central Arizona

Univ. of Arizona, M.S. Thesis, 41 p.

A study of four relic associations in the southern desert shrub formation of south-central Arizona. The study areas were situated on the mesa-like top of Black Mountain, 12 miles southwest of Tucson, an area physiographically inaccessible to livestock. Vegetation was analyzed by line transects. Mechanical analysis was made of the soils. The four communities studied were: Cercidium-Larrea (clay-loam soil); Hilaria-Larrea (clay soil); Bouteloua-Ayenia (clay; and Hilaria-cercidium (heavier soil). Menodora scabra was abundant in the Hilaria-Larrea and Cercidium-Larrea communities, in contrast to its rarity in grazed areas. Rather large numbers of dead plants were recorded. This high mortality may be a result of low rainfall and high temperatures since 1947.

Fernandez, Osvaldo A., Caldwell, Martyn M.

1975

Phenology and Dynamics of Root Growth of Three Cool Semi-Desert Shrubs Under Field Conditions

J. Ecology (63) :703

Many cool arid land shrub species exhibit much higher root/shoot biomass ratios than many warm desert shrubs even though mean potential evaporation/precipitation ratios are usually less severe in these cooler areas (Barbour 1973; Rodin & Basilevich 1965; Shalyt & Zhivotenko 1968; Sveshnikova 1968; Bjerregaard 1971; Fernandez 1974). These high root/shoot biomass ratios are particularly apparent in regions where most of the annual precipitation occurs in the winter months (Rodin & Basilevich 1965; L. E. Rodin, personal communication; Bjerregaard 1971). Cool semi-desert communities in northern Utah exemplify this situation. Root/shoot biomass ratios are of the order of 9 for the dominant shrub species. Soil moisture recharge results primarily from winter precipitation in the form of snow. When the upper part of the soil profile thaws in early spring, the soil is recharged to a depth of approximately 80-90 cm. Subsequent summer season precipitation is of significance only for recharge of the uppermost soil layers. Therefore, during the course of the main growing season from March to September, there is a steady decline of soil moisture in most of the profile. Soil moisture potentials during the drier portion of the year of less than -70 atm are not uncommon in these soils (Moore & Caldwell 1972).

Three prominent shrub species of this region, Atriplex confertifolia (Torr. and Frem.) S. Wats., Ceratoides lanata Nevski, and Artemisia tridentata Nutt. subsp. wyomingensis Beetle were studies as examples of cool semi-desert perennial species which possess profuse root systems composed almost of soil. The extensive root systems maintained by these species may be necessary in order to extract efficiently the available moisture infused throughout the upper metre of soil by the annual spring recharge.

This study was undertaken to assess the seasonal root system dynamics and root morphology of such plants in the field in order to investigate the hypothesis that, even though these plants maintain an extensive and profuse root system throughout the zone of primary soil moisture recharge, only a small fraction of the roots are actively growing at any one time. A phased activity of a large root system should allow

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a prolonged period of root system growth during much of the year facilitating an efficient utilization of the annual soil moisture allotment.

Ferrari, T.J.

1963

Causal Soil-Plant Relationships and Path Coefficients

Plant and Soil XIX (1):81

The use of the normal regression model to interpret the relationships between soil factors and plant characteristics such as yield and mineral content is open to certain objections. One of the most important of these is connected with the imperfections and limitations of the regression model used. In such a model the assumption is made that the so-called independent factors do not influence each other; in other words, a change in one factor does not result in a change in another independent factor. In many cases, however, this assumption is not valid; this particularly the case with investigations into the mineral relationships of plants.

Ffolliott, Peter F., Clary, Warren P., Baker, Malchus B., Jr.

Characteristics of the Forest Floor on Sandstone and Alluvial Soils in Arizona's Ponderosa Pine Type

U S D A Forest Service Research Note RM-308

The forest floor, defined as the accumulation of dead organic mater above mineral soil, affects hydrologic characteristics of a site (Johnson 1940, Rowe 1955), herbage production (Wahlenberg et al. 1939, Pase and Hurd 1958, Clary et al. 1968), and tree regeneration (Pearson 1950, Davis et al. 1968). It is also an important forest fuel component. Generally three layers are distinguished; the L Layer, unaltered organic matter; the F layer, partly decomposed matter, and the H layer, well decomposed matter.

In a previous study, the characteristics of ponderosa pine (Pinus ponderosa Laws.) forest floor on basalt and volcanic cinders were described (Ffolliott et al. 1968). The objectives of this current study were to characterize ponderosa pine forest floor on sandstone and alluvial soils, and compare these characteristics to those on soils developed from volcanic parent materials.

Ffolliott, Peter F., Larson, Frederic R., Thill, Ronald E.

U S D A Forest Service Research Note RM-342

The forest floor, defined as the accumulation of dead organic matter above mineral soil, has an important influence on tree regeneration, herbage production, and the hydrologic characteristics of a site. In addition, it is an important forest fuel component. Generally, three layers are distinguished: the L layer, unaltered organic matter; the F layer, partly decomposed matter; and the H layer, well decomposed matter.

Characteristics of the forest floor under Arizona's ponderosa pine (Pinus ponderosa) forests have been documented in previous studies (Ffolliott et al. 1968, 1976). The objectives of this Note were to: (1) describe the depth and weight characteristics of Arizona's uncut mixed conifer forest floor; (2) determine whether or not the amount of forest floor can be estimated from readily obtained stand and site variables; and (3) compare the characteristics of the forest floor developed under ponderosa pine and mixed conifer forests.

Fireman, M.; Hayward, H. E.

1952

Indicator Significance of Some Shrubs in the Escalante Desert, Utah

Botanical Gazette 14(2) :143-155 BA 27(7)18882

A report of a study of desert shrubs as possible indicators of agricultural potentialities of new lands. Plants and soils were examined to determine pH of soluble salt content and exchangeable sodium percentage. Soluble salt content was found to be higher under shadscale and greasewood than under sagebrush. The pH value in exchangeable sodium percentage was highest under greasewood.

Fletcher, Joel E., Martin, W. P.

1948

Some Effects of Algae and Molds in the Rain-Crust of Desert Soils

Ecology v.29 (1) :95

Rainfall-induced crusts on soil have been recognized for some time and their effect on infiltration, erosion, and plant growth pointed out by such investigators as: Duley and Kelly ('39), Schiff and Yoder ('41), Borst and Woodburn ('42), Beutner and Anderson ('43), Ellison ('45), and many others. These investigations without exception have shown that the formation of rain-crust greatly reduces water infiltration, increases runoff, and speeds up erosion. In 1941 Booth ('41) described an algal stratum over "hundreds of acres of badly eroded land in the southcentral United States." In contrast with a rain-crust, this algal layer did not slow down the rate of water infiltration and erosion losses minimized.

In the winter of 1944-45 following an extended succession of gentle rains an appreciable darkening of the well-established rain-crust over extensive acreages of desert soil in the vicinity of Tucson, Arizona, was noted. A cursory examination of the crust revealed dark, brownish-colored circular colonies of algae. Furthermore, when the crust was peeled from the surface of the soil, its tensile strength had been increased to the extent that pieces as large as 5 or 6 square inches and only 2 to 4 millimeters thick could be handled without disintegration (fig. 1). The underside of these algae-impregnated crusts had a fuzzy appearance with sand grains adhering to what proved to be fungus mycelium.

An extensive growth of algae and molds in the rain-crust of desert soils was considered to be important for at least 3 reasons: (1) The algal filaments and mold mycelium obviously holding the soil particles in place will probably reduce erosion and influence infiltration. (2) The synthesis of much organic matter and its subsequent decomposition undoubtedly alter the soil's structure particularly at the surface. (3) Appreciable changes in soil fertility should accompany such an extensive microbial development.

Flowers, S.

1934

Vegetation of the Great Salt Lake Region

Botanical Gazette 95(3) :353-418 BA 9(2)159

A report of a study of water, swamps, springs, deltas, and salt marshes in the area, and analysis of the vegetation to determine salt content. On the basis of these investigations certain plants can be used as indicators of saline conditions.

Flowers, S.

1961

Vegetation of the Navajo Reservoir Basin in Colorado and New Mexico

In A. M. Woodbury, et al., Ecological Studies of the Flora and Fauna of Navajo Reservoir Basin, Colorado and New Mexico

University of Utah, Anthropological Papers 55 :15-46

A good discussion of the flora and fauna of a typical arid area in Colorado and New Mexico.

Flowers, S.; Evans, F. R.

1966

The Flora and Fauna of the Great Salt Lake Region, Utah

p. 367-392. In H. Boyko, ed., Salinity and Aridity, New Approaches to Old Problems, W. Junk, The Hague 408 p. (Monographiae Biologicae 16)

Discusses adaptation of plants and animals to saline conditions.

Foote, L.E.; Jackobs, J.A.

1966

Occurence and Density of Tridens flavus as Related to Some Soil Factors

Agron. J. 58(4):412-414

No abstract available.

Fosberg, F.R.

1940

The Aestival Flora of the Mesilla Valley Region, New Mexico

Am. Midland Naturalist 23(3):573-593

A description of the vegetation of the Mesilla Valley and adjacent plains in the southern part of Dona Ana County, New Mexico, with notes on climate and substratum. Reference is chiefly to flora that flowers after the summer rainy season. Larrea flourishes where drainage is good, and is best developed on limestone, Alluvial fans and recent volcanic flows. It is not abundant but luxuriant in growth along washes, on porphyritic hills stunted Larrea is almost the only plant. On the flat grasslands the transition is broad except along the line of limestone Alluvium and porphyritic Alluvium where Bouteloua grows. Juniperus monosperma and chaparral are found on north slopes of foothills and in the canyons of the Organ Mountains.

Freeman, C. E., Dick-Peddie, W. A.

1970

Woody Riparian Vegetation in the Black and Sacramento Mountain Ranges, Southern New Mexico

The Southwestern Naturalist v.15 (2) :145-164

A comparative study of woody riparian vegetation was conducted between the elevations of 1853 and 2463 meters on three slopes of the Black and Sacramento mountain ranges in southern New Mexico. These two north-south oriented ranges are 180 kilometers apart and the study areas were at nearly identical latitudes. East- and west-facing slopes of the Black Range and the west-facing slope of the Sacramento Mountains were sampled.

Riparian vegetation on the slopes studied is generally similar and the elevational sequence of the species is remarkably uniform. Floristic differences were noted, however with 23 species being found only in the Black Range study area and 23 species being found only in the Sacramento Mountains study area. Differences in soils may be responsible for many of these floristic differences. The vegetation zones of the Black Range appear to be approximately 150 meters lower than those of the Sacramento Mountains. There is a trend toward shrub dominance of riparian zones at lower and upper elevations in the study areas while trees dominate the intermediate elevations. The west-facing slopes show similarities in average basal area of trees, average numbers of shrubs, and in the ratio of the trees to shrubs per plot at each sampling elevation when compared to the east-facing slope.

Fuller, W.H.

1975

Soils of the Desert Southwest

Univ. of Arizona Press, Tucson, AZ, 195 p., $7.50 paperback

A non-technical introduction to the soils of the desert Southwest - how and why they differ among themselves and with soils of humid climates, how they developed, why different soils have the physical and chemical characteristics they have, and how those characteristics may affect or limit the kinds of plants that can be grown on them. The treatment is strictly broadbrush and non-technical except for the last chapter on soil classification which identifies and describes the three major orders of desert-occurring soils: Aridisols, Entisols, and Mollisols and their suborders. An appendix includes five figures: the chemical cycles (nitrogen, phosphorus, carbon, and sulfur) and a soil texture chart. This is a clear and concise introduction to desert soils and will be interesting and informative to all who must deal with soils, from the urban dweller with a few flower beds or vegetable garden to the farmer who makes his living from the soil.

Gail, Floyd W.

1921

Factors Controlling the Distribution of Douglas Fir in Semi-Arid Regions of the Northwest

Ecology v.2 (3) :281

The aim of the present investigation was to obtain quantitative data on the factors which control the distribution of Douglas fir (Pseudotsuga taxifolia in semi-arid regions of northwestern United States. It has been pointed out, as the result of observations in different localities, that Douglas fir is confined largely to north facing slopes, while south slopes are practically without forest trees except where outcropping rocks help to furnish sufficient shelter and moisture for the establishment of seedlings (2, 7, 10, 12). In that part of Idaho adjacent to the Spokane region in Washington, included in Merriam's Arid Transition Area (5), the Douglas fir grows chiefly on the north and northeast slopes. These are considerably steeper than the southwest slope. The prevailing winds are from the southwest.

Garcia, R. M., Pase, C. P.

1967

Moisture-Retention Capacity of Litter Under Two Arizona Chaparral Communities

U. S. Forest Service, Research Note RM-85 :2

Retention of moisture in the litter layer affects soil-moisture supply and, therefore, plant growth and percolation water yield.

Moisture-retention capacity of chaparral litter was studied at three sites in the Tonto National Forest, Arizona. Arrangement of litter appeared to have little effect on water-holding capacity, and therefore disturbed and undisturbed litter samples would be expected to yield reasonably similar results. Within each community, litter weight varied substantially more than did water retained per gram of litter. Pringle manzanita litter held more water per gram of litter than did shrub live oak but total litter produced was less. Increasing the litter layer under plants may be a possible way of increasing vegetative production on arid lands by increasing the moisture content of soil near the plants. (Blecker-Ariz)

Garcia-Moya, Edmundo, McKell, Cyrus M.

1970

Contribution of Shrubs to the Nitrogen Economy of a Desert-Wash Plant Community

Ecology v.51 (1) :81

Total nitrogen incorporated in the shrubs of a low-fertility desert plant community (principally Acacia Gregii, Cassia armata, and Larrea divaricata) was estimated from the nitrogen content of plant parts, the total weight of plants and proportional weight of roots, stems, and leaves, and the number of plants per unit area. The average nitrogen content of shrub leaves, stems, and roots was 1.31%, .87% and .80%, respectively. Shrub cover occupied 20% of the ground surface and contained an average of 29 kg nitrogen/ha. Legume shrubs were not significantly greater in nitrogen content than nonlegume shrubs.

Soil nitrogen content decreased significantly as a function of radial distance from the center of the shrub canopy. Areas between shrubs averaged .019% nitrogen in the surface inch of soil. Soil nitrogen content decreased significantly from the surface to 90-cm depth and was closely related to shrub species and their root-distribution patterns.

Gardner, J. L.

1950

Effects of Thirty Years of Protection from Grazing in Desert Grassland

Ecology v.31 (1) :44

It has long been recognized that areas protected from livestock serve as useful adjuncts in evaluating effects of grazing and in following the steps in recovery from overgrazing. Expense of fencing and loss of production usually militate against the use of large exclosures for these purposes. Small areas of an acre or two are valuable for comparison with their immediate surroundings; they do not, however, afford a variety of conditions, such as soil, slope, and aspect, and they are often severely overgrazed by rodents. Thus when the opportunity of studying a large protected area is presented, the study is well worth the time devoted to it. The information presented in this paper was gathered in a 320-acre tract of desert grassland situated about 10 miles south of Silver City, New Mexico. Except for the presence of about forty cattle for a month or two during the spring of 1948, the area has been protected from domestic livestock since 1918.

Gardner, J. L.

1951

Vegetation of the Creosotebush Area of the Rio Grande Valley in New Mexico

Ecological Monographs v.21 (4) :379

Table of Contents

The valley of the Rio Grande in New Mexico is bordered by a narrow belt of brush dominated mainly by creosotebush (Larrea divaricata) nearly as far north as the mouth of the Rio Puerco. This area is one of sparse vegetation and low rainfall. Part of the precipitation, however, falls as intense storms, resulting in flash floods from arroyos. These flash flows cause appreciable damage to highway and irrigation installations and to crops and agricultural land in the valley. The information presented in the present paper was collected during the course of investigations on arroyo control along the Rio Grande. It is derived from notes and measurements made in

the shrub belt from Las Cruces, New Mexico, as far north as creosotebush is prominent in the vegetation, a distance of approximately 170 miles (Fig. 1).

The vegetation of the area nearly as far north as San Marcial was regarded by Shreve (1942) as Chihuahuan Desert. Clements and others, on the other hand, have considered it to be Desert Plains Grassland, with the shrub-dominated areas representing grazing disclimax or successional stages (Clements 1934; Clements & Shelford 1939; Cooperrider & Hendricks 1937: Weaver & Clements 1938; Wooton 1922). Clements (1944) regarded this part of the area as belonging to the driest of three faciations of the Desert Plains Grassland in the United States. Although, if the writer interprets the different concepts correctly, a part of the difference lies in definition of the term desert, part seems to lie in different concepts of the nature of the climax vegetation in the area.

Gates, Dillard H., Stoddart, L. A., Cook, C. Wayne

1956

Soil as a Factor Influencing Plant Distribution on Salt-Deserts of Utah

Ecological Monographs v.26 (2) :155

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The effects of vegetation on soil and the effects of soil on vegetation have been studied and observed for many years. Perhaps arid-desert range lands have been studied least and as a result are not well understood.

114-A

As human populations increase there will be additional need for agricultural production, and these lands may be put to higher use, perhaps even to irrigated crop production. Basic to management of these lands is an understanding of the vegetation they are now supporting, what they supported prior to their use by domestic livestock, and why the present vegetation grows to the exclusion of other vegetation types.

These studies were conducted in western Utah, where the vegetation is largely dominated by shrubs having various degrees of tolerance to drought and soil salts. The area is referred to herein as salt-desert because soil salts as well as low precipitation restrict water intake by plants. This desert is typical of the northern desert shrub vegetation dominated by Artemisia and Atriplex. Many woody shrub species occur in pure types from which other species are virtually excluded. The transition from one vegetation type to another generally is abrupt.

Grazing in the past 60 to 70 years is believed responsible for considerable change in floristic cover on the salt-desert. Some perennial herbaceous species native to the Great Basin vegetation have decreased or perhaps even disappeared over extensive areas. Also, some species of shrubs have been reduced by grazing. Often, annual herbs have become established, especially in areas devoid of other plants. The result of these changes in floristic composition is a less desirable forage and consequently a decline in grazing capacity.

Land classification on these ranges is an important function of the administering agencies. To appraise the present condition, normal condition or climax must be understood. The Bureau of Land Management, which controls most of this salt-desert land, must classify it as to whether it is potentially arable. Land use, grazing capacity, and management practices should be based on correct classification of the lands.

Gehlbach, F.R.

1963

The Guadalupe Ecosystem: An Approach to Basic Plant Ecological Research in the Nat'l Park Service

Univ. of Michigan, PhD Dissertation, 179 p.

Dominance characteristics of common plants and the structure and floristic composition of Sinusiae and plant communities are described by analyzing density, frequency, coverage, height, and distance data. Of leading species, shrubs contribute the greatest biomass to the ecosystem, followed by half-shrubs, ground plants, and trees. A vegetational continuum is present. Plant distributions are closely allied with a moisture gradient that varies according to elevation, exposure, soil particle size, etc. Evergreen woodland, Chihuahuan Desert, desert shrub formations contain eight broadly defined communities, which differ floristically from those of neighboring ecosystems, formations, and communities are placed in an elevational-edaphic matrix for synthetic interpretive purposes, but the time dimension is equally important. Guadalupe vegetation has fluctuated in space and species composition during Pleistocene and Holocene time. The ecosystem is largely a product of post-Pluvial climatic alterations and the impact of man through livestock grazing and similar activities.

Gehlbach, Frederick R.

1967

Vegetation of the Guadalupe Escarpment, New Mexico-Texas

Ecology, v.48 (3) :404-405

The Guadalupe Escarpment, a Permian limestone reef, is the eastern face of a semiarid-mesothermal mountain mass that rises 1,000-4,000 ft. above the southwestern edge of the Great Plains. Phytocenoses range from xerophytic (Larrea, Flourensia, Acacia dominance types) on the silty to gravelly plains, through less xerophytic (Agave, Dasylirion, Juniperus dominance types) on gravelly to bouldery lower slopes, to comparatively mesophytic (Juniperus, Quercus, Pinus dominance types) on rocky upper slopes and the escarpment peneplain. This general gradient is a vegetational continuum in which species' ecologic amplitudes are distinct but form overlapping assemblages of similar structure.

Special environmental gradients are produced by topographic discontinuity. On low elevation canyon slopes, south-facing exposures support more xerophytic dominance types than north-facing exposures, although floristic differences are minimal. At highest base levels and slope elevations, south-facing exposures support the most xerophytic of all canyonside vegetation, and floristic differences between slopes are maximal. Dominance types with a tree stratum are well developed inside canyons; they form a continuous streambed-stream terrace-canyonhead sequence of increasing mesophytism. Canyon depth and water are important in supporting relict woodland dominated by Acer, Quercus, Juniperus, and Juglans.

Height and coverage as stratal features plus growth form contribute to a synusial description of the vegetation. Based on relative concordance of synusiae, shrub desert, succulent desert, evergreen woodland, and deciduous woodland plant formations are present. Microphyllous vs. succulent-semisucculent shrubs and half-shrubs distinguish the two desert formations. Narrow and broadleaf evergreen trees vs. broadleaf deciduous trees distinguish the two woodland formations. A mid-gradient predominance of structural diversity characterizes the ecosystem.

Comparisons with other southwestern desert regions reveal that dominance types vary considerably; but the same formations recur, although in differing patterns based largely on regional edaphic differences. Formations are shifted toward the xerophytic end of an environmental gradient in the igneous-based Chisos Mountains, Texas; and succulent desert is not well developed on the north side of these mountains. Succulent desert of the Chihuahuan Desert region may not be classable with that of the Sonoran Desert region, because a tree stratum is added in the latter region. Succulent desert and evergreen woodland of the Guadalupe Escarpment could have had a common Madro-Tertiary origin based on evergreen-succulent dominance and paucity of deciduous growth forms.

Glendinning, R. M.

1949

Desert Contracts Illustrated by the Coachella

Geographical Review 39 :220-228

Discusses the Coachella Valley portion of the Colorado Desert of California. The valley originally had desert vegetation with some halophytic types near the Salton Sea. Paloverde and smoketree occur on fans and pediments, and some cacti are scattered through the area.

Goldman, E. A.

1916

Plant Records of an Expedition to Lower California

U. S. National Herbarium, Contributions 16 :309-371

A very well illustrated and useful series of descriptions of some of the more distinctive plants in lower California; includes data on distribution, and notes on habits and habitats.

Goodman, P. J.

1973

Physiological and Ecotypic Adaptations of Plants to Salt Desert Conditions in Utah

J. Ecology v.61 :473

Ecotypic variation has been found recently in several salt desert plant species (Workman & West 1967, 1969; Clark & West 1971; Goodman & Caldwell 1971). This finding is interesting, since it is difficult to explain the distribution of desert plants on any other basis (Gates, Stoddart & Cook, 1956; Mitchell, West & Miller 1966; Gasto 1969). Plant distribution is itself economically important since the forage value of the species varies widely and the proportion of useful species determines the grazing value of the desert rangeland.

Two kinds of distribution of desert species need to be explained. The more striking of these is the mosaic distribution which covers large areas. Each piece of the mosaic is a few hundred metres in diameter and differs slightly from its neighbours in species composition or dominance.

The second distribution pattern concerns the subdominant species. Some of these have a much wider distribution than the dominants and are thinly spread over areas where the soil conditions, such as salinity, may vary eighty-fold. This represents an unusually high degree of tolerance and is, in a sense, the opposite problem to the perplexingly restricted range of the mosaic-dominant species of the same habitats.

This paper describes an investigation of these complex situations directed particularly to finding whether the existence of a range of ecotypes could contribute to making artificial boundaries between communities in the mosaic zone, or could blur the boundaries between communities of the tolerant species. The investigation had three stages. First, several species were measured for growth and nutrient response in different situations where ecotypes might occur, in the field at Curlew Valley, in north-western Utah. Secondly, typical plants were brought from the possible ecotype situations into uniform laboratory culture and compared for growth and, thirdly, the possible ecotypes were given graded salt concentrations to test their interaction with different environments in the laboratory, and to relate these to their field behaviour.

Graham, E. H.

1937

Botanical Studies in the Uinta Basin of Utah and Colorado

Carnegie Museum, Anals 26 :1-432

A useful desert reference as the lower altitude area falls within the scope of desert study. Includes a sketch of physiography, geology, and climate, compares altitudinal vegetation zones of various workers in surrounding regions, and divides the mixed desert shrub into 7 associations, giving a good discussion of plant communities for each.

Griffin, James R.

1964

Isolated Pinus Ponderosa Forests on Sandy Soils Near Santa Cruz, California

Ecology, v.45 (2) :410

About 7,000 acres of sandy soil derived from Miocene marine sand deposits occur in central Santa Cruz County, California. Within the Santa Cruz Mountains, Pinus ponderosa is restricted to open forests on these sandy soils. The pine communities, apparent edaphic "climaxes," are surrounded by redwood and mixed evergreen forests on soils of finer texture. Regional vegetation patterns may be governed by soil moisture-holding capacity, low fertility of the sands, and the degree of flammability of the vegetation.

Gulmon, S. L., Mooney, H. A.

1977

Spatial and Temporal Relationships Between Two Desert Shrubs, ATRIPLEX HYMENELYTRA and TIDESTROMIA OBLONGIFOLIA in Death Valley, California

J. Ecology 65 :831-838

On the floor of Death Valley, California, two perennial shrubs commonly grow together. Precipitation normally occurs in small amounts and only a few times a year. One of the species, Atriplex hymenelytra (Torr.) Wats., is long-lived and is very conservative in its water use; it grows in winter and closes its stomata during summer. In contrast, plants of Tidestromia oblongifolia Standl. normally live for only 5 years, and can reproduce in their first year; they draw heavily on soil water during the summer growth period, due to their lack of stomatal restriction of water loss. These two species are thus temporally separated, both by seasonal behaviour and by life-span. They are, in addition, spatially separated on a micro-scale. Tidestromia evidently principally utilizes stored soil water during its vegetative growth phase and rapidly becomes reproductive, whereas Atriplex is dependent on the occasional replenishment of moisture during its long life-span.

Haase, E.F.

1970

Environmental Fluctuations on South-Facing Slopes in the Santa Catalina Mountains of Arizona

Ecology 51:959-974

Solar radiation, evaporation, air and soil-temperature extremes, soil moisture, and precipitation were measured on four aspects (SSE, S, SSW, SW) of constant slope in the desert foothills of the Santa Catalina Mountains over a one-year period. The sequence of warmest and driest aspect may change with the environmental factor considered or the time of year. Drought extremes reached a high peak on the SW aspect during the arid spring, although druing all other seasons the SW aspect had the mildest drough conditions. The warmest and driest aspect during the summer rainy season was SSE, during the winter rainy season it was S, and during the fall arid season S and SSW were nearly equal. Few significant differences were found throughout the year between S and SSW aspects. When vegetation and environment are considered, the warmest and driest aspect may also change with the species because plants may utilize different microenvironments at different seasons and vary in their response to similar environmental changes.

Haase, E.F.

1972

Survey of Floodplain Vegetation Along the Lower Gila River in Southwestern Arizona

Arizona Academy of Sci., J. 7(2):75-81

The vegetational survey based primarily on aerial photography along the lower Gila River Floodplain resulted in the description of the following six communities: typha, tamarix-pluchea, prosopis, suaeda-allenrolfea, atriplex, larrea-prosopis. A high degree of environmental instability in the past resulting from vegetation removal, dam building, irrigation, and related changes in drainage patterns has led rapidly to the dominance of the exotic tamarix pentandra pall. On over 50 percent of the 6622 heotars surveyed, tamarix-dominated communities are presently components of an unstable ecosystem because of their essentially monotypic growth pattern, the danger of catastrophic fire, the unpredictably fluctuating groundwater table, and anticipated clearing of vegetation by man. Typha communities appear to have increased significantly in the last 20 years, but their considerable dependence on contemporary irrigation and drainage practices also limits the natural stability of the ecosystem.

Haase, E.F.; Schreiber, H.A.

1972

Topographic Relations of Vegetation and Soil in a Southeastern Arizona Grassland

Southwestern Naturalist 16(3-4):387-401

Variation in plant cover with aspect, slope position, and soil attributes was investigated on grasslands in the Walnut Gulch Experimental Watershed in Southeastern Arizona. Two plant communities were defined, based upon coefficients of interspecific association among 11 species. The Bouteloua eriopoda (black grama) community was found primarily on SW to SE aspects, Hathaway soils and upper slopes with soil attributes of relatively low moisture retention, organic carbon and clay content, but high pH, sand and gravel content. The Hilaria belangeri (curlymesquite) community was found primarily on NW to NE aspects, Bernardino soils and lower slopes with soil attributes the converse of the other community. H. belangeri appears to be limited in its distribution on SW to SE aspects because the greater solar irradiation on these aspects, at other than the two to three-month summer growing season, causes drought conditions which reach critical proportions sooner in the arid spring or fall.

Hall, H. M.; Grinnell, J.

1919

Life-Zone Indicators in California

California Academy of Sciences, Proceedings 9(2) :37-67

The authors do not agree entirely with Merriam's temperature factors, but believe that life-zone concepts are useful, and that certain plants and animals could be used as indicators. They noted that in desert regions corresponding zones were lower on large mountains than on isolated peaks, and that rock surfaces were usually warmer than other surfaces. Largely a discussion of floras, including the origins and distributions of floras of 8 separate regions.

Halvorson, W.L.

1972

Environmental Influence on the Pattern of Plant Communities Along the North Rim of Grand Canyon

American Midland Naturalist 87(1):222-235

The pattern of vegetational communities along the north rim of the Grand Canyon in Northern Arizona is described. It consists of Pinus edulis (Pinyon Pine) forest, Artemisia tridentata (sagebrush), and P. ponderosa (Ponderosa Pine) forest. Microenvironmental studies showed that P. edulis occurred only as a thin band along the rim due to climatic conditions created by the canyon. In drier sites behind the band of P. edulis, A. tridentata communities develop. These communities are common below the Kaibab Plateau (1500-1800 m), but rare and restricted to areas in close proximity to the canyon at elevations of 2300-2400 m. P. ponderosa forests developed only north of the P. edulis forest and A tridentata desert where moisture and other microenvironmental conditions were favorable. Soil and other characteristics of the P. edulis and artemisia sites were desert-like, whereas the P. ponderosa sites were more typical of coniferous forest areas. Evidence is presented to show that this change, which occurs in a very short distance, is due to the effects of the Grand Canyon and not to change in elevation which is typical for the Rocky Mountain areas.

Hanes, Ted L.

1965

Ecological Studies on Two Closely Related Chaparral Shrubs in Southern California
Ecological Monographs V. 35(2):213
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Hanes, Ted L., 1965
Page Two

Knowledge of the physiological ecology of California chaparral vegetation is limited. Previous studies on chaparral shrubs have dealt mainly with seasonal growth and flowering cycles, regrowth after fire, variation in foliar osmotic concentrations, and transpiration rates in response to seasonal environmental changes. This study compared the seasonal metabolic activities of two closely related chaparral shrubs in response to seasonal environmental changes. The objective was to explain how, in certain areas of southern California, these two closely related species of apparently similar ecology can persist in the same habitats.

Hanson, H. C.

1924

A Study of the Vegetation of Northeastern Arizona

University of Nebraska Studies 24 :85-175

An excellent study of vegetation including the sagebrush zone, which lies below 5200 feet elevation. This area is the southernmost extension of sagebrush (Artemisia-Atriplex association). Rainfall is about 7 inches, mostly in summer; April, May and June are dry.

Hanson, H. C.

1949

The Agroclimatic-Analogue (Homoclime) Technique in Plant Introduction and Distribution of New Selections

Agronomy Journal 41(5) :186-188

A very good discussion of the agroclimatic-analogue technique for comparing areas, and as an aid to introduction and distribution of new selections. Describes methods used to identify similar ecological areas in different countries by comparing all available climatological, geographic, and soil data.

Harris, S.A.

1974

Annual Soil Moisture Regimes in the Rooting Zone Across the Prairie-Forest Boundary of Southwest Alberta

J. Soil Science 25(4)

Vegetation cover is shown to play a major role in determining the soil moisture content in the Front Range of the Rocky Mountains near Calgary. Thus lodgepole pine abstracts more moisture from the soil both in summer and winter than aspen, while least moisture loss is experienced on bare soil. Clearly vegetation cover must be kept constant when comparing two soils. Additional important variables are aspect and parent material. It was also found that permanent (15 bar) wilting-point, as commonly used, bears little relation to the permanent wilting-point of even the more moisture-loving native trees studied. They all do not wilt until a much lower content is reached.

Harshberger, J. W.

1911

Phytogeographic Survey of North America

G. E. *Stechert* and Company, New York, 790 p.

A comprehensive report on the vegetation of North America based upon the best knowledge available at the time. Considers the desert area as four regions: (1) Great Basin region, including Oregon, Nevada, and Mojave Desert; (2) Rocky Mountain region, including northeastern New Mexico and west Texas; (3) Chihuahuan Desert region, including parts of west Texas and southern New Mexico, and eastern Arizona; and (4) Western Madre region, in Mexico extending into southern Arizona. Well illustrated with 18 plates, 32 figures, and a vegetation map on a scale of 1:40,000,000. About 4 pages of the extensive bibliography are devoted to desert vegetation.

Haskell, G.

1951

pH Tolerance and Polyploidy in Angiosperms

Plant and Soil III (3):223

It is well known that Angiosperm ecology, the grouping of species according to their habitat, has demonstrated the occurrence of ecological communities such as sand, salt-marsh, chalk, and heath floras. Yet cyto-ecology, the relation of plant chromosomes and plant ecology, is virtually an unexplored field in studies on plant and soil inter-relationships. This paper considers the concept of a relation between chromosomes and local plant distribution, as compared with the wider interpretation of chromosomes and plant geography already reviewed by Cain (1944). It reviews some aspects of diploidy and polyploidy of flowering plant species in relation to their soil acidity preferences and gives special consideration to calcicolous species.

Havranek, W. M., Benecke, U.

1978

The Influence of Soil Moisture on Water Potential, Transpiration and Photosynthesis of Conifer Seedlings

Plant and Soil 49 :91-103

The influence of soil moisture content and soil water potential on plant water potential, transpiration and net-photosynthesis of potted larch (Larix decidua), spruce (Picea abies) and pine (Pinus cembra) was studied under constant and close to optimum conditions in a laboratory.

The 'equilibrium' plant water potential measured under 'non-transpiring' conditions came close to soil water potential, but in moist soil the equilibrium potential was slightly lower, particularly in larch where transpiration was not fully arrested. In very dry soil, plants had higher water potential than soil, presumably due to roots exploiting the wettest points within the soil.

Pine, spruce and larch utilised a large part of soil moisture (down to 25wt.% soil water content or--1.5 bars potential) while maintaining plant water potential near--8, --9.5 and--12.5 bars respectively. A similar pattern occurred in dry soil. The differences between species are explained by differing stomatal sensitivity to water potential.

Pine began a gradual reduction in gas-exchange below a soil water potential of--0.4 bars. Larch showed no marked reduction until the soil potential fell to--3.5 bars but below this the shut-down in gas-exchange was rapid. Spruce lay in between.

In spite of the early and sensitive gas-exchange reduction with decreasing soil moisture, pine maintained the highest net photosynthesis/transpiration ratio and thus used limited soil water more slowly and economically than the other species.

Seedlings maintained a higher rate of gas-exchange in strong light than in weak light, especially at low soil water potentials.

Hayward, H. E.

1956

Plant Growth Under Saline Conditions

In Utilization of Saline Water, Reviews of Research. Rev. ed. Unesco, Paris, Arid Zone Research 4 :37-71

A good review of research relating to the biological problems of plant growth under saline and alkaline conditions. Includes a classification of soils and water quality as related to plant growth. Covers salt tolerance, and notes the occurrence of saline and alkaline soils in Australia, India, and the Western Hemisphere. Includes a bibliography of 256 references.

Hayward, H. E.; Wadleigh, C. H.

1949

Plant Growth on Saline and Alkali Soils

Advances in Agronomy 1 :1-38

No abstract available.

Herbel, C. H., Ares, F. N., Wright, R. A.

1972

Drought Effects on a Semidesert Grassland Range

Ecology, v.53 (6) :1084-1093

A vegetational survey conducted on the Jornada experimental range in southern New Mexico indicated that drought occurrence is more frequent in areas that have minimal, rather than optimal, precipitation and may lead to severe reductions in plant yields in the area of minimal precipitation. Data taken annually from 1941 through 1957 provided the basis for a study of the effects of the Great Drought of 1951 through 1956. Observation of cover and yields, based on a consideration of landform and soil characteristics, indicates a successional change of cover as drought modifies growth patterns. Drought damage was much more severe on the deep sands where the impermeable caliche layer occurred at greater depths, whereas moisture relations were better in shallow sands. Thinned grasslands were invaded by Prosopis juliflora; however, grass losses were held to a minimum with winter-spring and summer precipitation. Tabulated data indicate that annual and seasonal (July-December) precipitation for the 1951-56 period was about 55 percent of the 1941-1950 averages with the most severe drought years being 1951, 1953, and 1956. (Bahre-Arizona)

Helm, V.; Box, T.W.

1970

Vegetation and Soils of Two Southern High Plains Range Sites

J. Range Management 23:447-450

Soil and vegetational properties associated with a high lime and a mixed plains site on the Texas High Plains were analyzed. Density of grass cover was similar on both sites, but the high lime site supported a higher percentage of climax grasses. Mesquite trees were dense on the mixed plains site, but virtually absent from the high lime site. The high lime site was characterized by a grayish, strongly alkaline soil high in clay content and low in bulk density; the mixed plains site had a brownish moderately alkaline soil high in sand content and high in bulk density. Phosphorus, sodium, pH, and organic matter were higher in the high lime soils.

Herbel, Carlton H., Ares, Fred N., Wright, Robert A.

1972

Drought Effects on a Semidesert Grassland Range

Ecology 1972 v.53 (6) :1084

A vegetational survey on the Jornada Experimental Range in southern New Mexico, taken annually from 1941 through 1957, is the basis for a study of the effects of the great drought of 1951 through 1956. Both cover and yields were studied. Observations were stratified into seven classes based on a consideration of landform and soil characteristics. Seasonal and annual precipitation during the drought averaged 55% of the pre-drought average. The most severe drought years were 1951, 1953, and 1956.

Both the cover and yield of Buoteloua eriopoda (Torr.) Torr., the dominant species on the upland sandy soils, were greatly reduced by drought. However, drought damage was much more severe on the deep than on shallow sands. When the impermeable caliche layer occurred at shallow depths, moisture relations during drought were apparently much better than when caliche occurred at greater depths.

Another result of drought was the invation of Prosopis juliflora (Sw.) DC in areas where grass stands have been thinned by drought.

Sporobolus spp. and Aristida spp., minor components of the climax, were more susceptible to drought damage than Bouteloua eriopoda.

Yields of perennial grasses per unit cover were as great during the drought as prior to the drought. Both winter-spring and summer precipitation are important in preventing death losses of black grama. In arid areas it seems necessary to consider both cover and species composition in arriving at a potential for a site.

Hironaka, M.

1963

Plant-Environment Relations of Major Species in Sagebrush-Grass Vegetation of Southern Idaho

University of Wisconsin, Madison (Ph.D. dissertation) 138 p.
BA 45(2)4840

Moisture preference of species was determined by frequency of occurrence of individual species in each of the four Great Soil Groups represented in this study. Stands located in the western one-half of the state were treated separately from those in eastern Idaho to determine whether or not distribution of precipitation also has significant effects on sagebrush-grass vegetation.

Hladek, K. L., Hulett, G. K., Tomanek, G. W.

1972

The Vegetation of Remnant Shale-Limestone Prairies in Western Kansas

The Southwestern Naturalist v.17 (1) :1-10

Floristics, vegetation indices and soils were studied on 65 remnant stands within the shale-limestone region of western Kansas.

An environmental gradient, consisting of five moisture classes, was established to study species distributions and community structure. Most species exhibited continuous distributional patterns in response to the moisture gradient. Mesic habitats were low in species numbers while drier sites exhibited a greater species diversity. The dominant grasses, Andropogon gerardi, Andropogon scoparius and Bouteloua gracilis were to ubiquitous in their distribution to be used in community delineation; therefore, four communities based on indicator species were established within the study area. These communities were: very-dry (Lesquerella--Tetraneuris), dry-mesic (Salvia-Sporobolus), mesic (Amorpha--Euphorbia) and wet-mesic (Poa--Rosa--Euphorbia).

Houston, Walter R.

1961

Some Interrelations of Sagebrush, Soils, and Grazing Intensity in the Northern Great Plains

Ecology v.42 (1) :31

The group of plants called sagebrush (Artemisia spp.) includes many species which vary widely in their adaptability, growth form, longevity, and palatability to livestock. These plants comprise a substantial portion of the vegetation on many western rangelands, and often characterize the landscape over wide areas. Information is limited on the influence of soils, soil characteristics, and grazing on distribution and abundance of even the more common species of Artemisia. This paper reports a study of the effects of grazing rates and soil differences on abundance and growth characteristics of Artemisia tridentata and A. cana, two of the important sagebrush species in the Northern Great Plains.

Houston, Walter R.

1961

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Hulett, G.K.; Van Amburg, G.L.; Tomaner, G.W.

1969

Soil Depth-Vegetation Relationships on a Shallow Limy Range Site in Western Kansas

J. Range Management 22:196

Soil depth heterogeneity within the shallow limy range site in western Kansas results in differences in range composition and production. Deep soils produce more forage than shallow (<4") soils. Such variations in production within an apparently uniform range site should be considered when evaluating range condition and establishing stocking range.

Humphrey, R.R.

1970

The Cirio, The Tallest Tree of the Sonoran Desert

Cactus and Succulent J. 42(3):99-101

The author reports on the tallest specimens of Idria columnaris from Baja California: 76 ft 6 in from Sierra de Los Angeles and 72 ft 6 in from the La Virgin area. These areas may have favorable climatic and soil factors, and wind damage may be reduced due to the protection of hills. The age of the Boojums may be 700 to 800 years old.

Hunt, C.B.

1966

Plant Ecology of Death Valley, California

USGS, Prof. Pap. 590, 69 p.

The author describes the composition and environment of lower Sonoran plants on and along the foot of gravel fans. Three different soil conditions occur: the central saltpan which covers more than 200 mi^2 where salts are excessive for flowering plants; a sandy belt about a mile wide at the edge of the saltpan where groundwater is shallow and many Phreatophytes grow; and gravel fans between the sandy ground and the foot of the mountains, the habitat for Xerophytes. Nine kinds of Phreatophytes distributed with respect to the salinity of the groundwater occur around the edge of the saltpan. Five groups of Xerophytes are distinguished on the gravel fans. Plant distribution is determined by the quantity and quality of the water supply; Phreatophytes by the the occurrence of shallow ground water and differences in groundwater salinity; Xerophytes by the absence of a shallow water table and the quantity of vadose water in the ground. Distributions in relation to brine level are presented for flowering plants, algae, fungi, and bacteria.

Hussain, S.S.; Quadir, S.A.

1970

An Autecological Study of Euphorbia Caducifolia Haines

Vegatatio 20(5/6):329-380,   BA(52)30708

The environmental factors controlling the distribution, growth, abundance, and sociability of E. Caducifolia were studied in the area up to 70 miles from Karachi. Phenological observations on most abundant on flat plains, less on slopes and banks of dry streams, growth is best on sand dunes of plains, poor on hills, especially their S slopes. The plant usually occurs in clumps, singly only the hills. Soils over 30 inches deep are more favorable than shallow soils. Soil analyses are given. The plant provides protection for many plants. Rainfall results in profuse growth of ephemeral annuals under the bushes of E. Caducifolia; due to the effects of wind most grow on the north and east sides of the bush. Mature branches of the Euphorbia cannot reproduce vegetatively, but some of the young branches can. Relative water content of the plant is high since it is a succulent. There was a high germination percentage following chemical treatment as well as mechanical scarification, but seeds remain viable for only three weeks.

Hyder, D.N.; Bement, R.E.; Remmenga, E.E.; Terwilliger, C.Jr.

1966

Vegetation-Soils and Vegetation-Grazing Relations From Frequency Data

J. Range Management 19:11

An upland vegetational continuum and three bottomland associations are interpreted from frequency data, but intra-site heterogeneity masks vegetation-grazing relations. Summer-long grazing at different intensities for 23 years has not affected the frequency percentages of species to a great extent.

Jaeger, E. C.

1941

Desert Wild Flowers

2nd Ed. Stanford University Press, Stanford, California 322 p.
BA 16(5)13152A

Contains descriptions, drawings and photographs of more than 750 plants of the California deserts, and information on their distrubition in other areas. Well illustrated. Gives excellent coverage of desert regions of California and fairly good coverage of Arizona and Nevada. Discusses geographical range, altitude distribution, and landform types upon which the plants occur.

Jameson, Donald A., Williams, John A., Wilton, Eugene W.

1962

Vegetation and Soils of Fishtail Mesa, Arizona

Ecology V.43 (3) :403

Fishtail Mesa is an island plateau in the Grand Canyon of northwestern Arizona near the junction of Kanab Creek and the Colorado River (Fig. 1). Although isolated by canyons 1,000-3,000 ft. deep, it is similar in elevation, geology, and vegetation to the "mainland" of the Kaibab Plateau. Fishtail Mesa covers about 1,430 acres, and the elevation is 6,000-6,200 ft. Because the mesa has never been grazed by domestic livestock and has been visited by few people, it provides a study area where vegetation and soils have not been altered by man or domestic stock. The mesa was studied to provide management information for similar, but grazed, areas.

Jensen, H. A.

1947

A System for Classifying Vegetation in California

California Fish and Game 33(4) :199-266 BA 23(1)204

One of the best and most detailed vegetation surveys made in the United States. Describes a system, based on aerial photographs, used for classifying vegetation in California. All vegetation classes described are illustrated by ground photos. Lists approximately 1700 California plants with the symbols used for them in the California Vegetation Type Survey.

Johannessen, Carl

1958

Higher Phosphate Values in Soils Under Trees Than in Soils Under Grass

Ecology v.39 (2) :373

The water-soluble phosphate values in the soil are higher in the tree-covered land than in similarly situated grassland in one transect of soil samples in California. Frank Harradine and Hans Jenny collected the soil samples which are listed in Harradine's (1954) unpublished doctoral dissertation. The phosphate analyses of these samples were carried out in the Soils Laboratory in the University of California. The significance of the phosphate values in this tree-grass dichotomy went unnoticed until I examined them.

The sites were from a transect extending up the foothills to the crest of the Sierra Nevada in Fresno County, California. For their purposes they sampled sites that were comparable in slope (16-28°), aspect (S.E. & E.), age (mature), parent material (granodiorite), and organisms (no barrier to seed movement present). For any given location three samples were taken; these had the same climate. Over the transect as a whole, climate was the variable that was of primary interest. The change in elevation provided the basis of the change in climate. I utilized only the lower portion of the transect. At the lower elevations three samples of soil were taken at each site. One sample was taken under each of the following vegetation types where this was possible: oaks (black oak, Quercus kellogii; blue oak, Q. douglasii or live oad, Q. wislizenii), pines (digger pine, Pinus sabiniana or ponderosa pine, P. ponderosa) and grass (Bromus, Festuca and Avena).

The portion of the transect selected for my phosphate study begins at 750 feet at the San Joaquin Range and Experiment Station and extends to the Beal River and Highway 168 at an elevation of 4100 feet. No evidence of cattle droppings, trailing, etc., were observed on seven of the thirteen sites in this portion of the transect. Three sites had evidence of cattle and at the three other sites no samples of soils under grass were taken. The seven

comparable sites without evidence of cattle were used in this study (Table I). At one of the seven sites there were only grass and oak; on the remaining six sites the soil was sampled under grass, pine and oak.

Johnston, Marshall C., Warnock, Barton H.

1962

The Ten Species of Croton (Euphorbiaceae) Occurring in Far Western Texas

The Southwestern Naturalist v.7 (1) :1-22

Johnston (1959,1960) published keys for the nineteen species of Croton in Texas, and gave some geographical and ecological information. The great importance of species of Croton in the vegetation of western Texas, the accumulation of new details of distribution as correlated with soils and topography, and the acute need for descriptions of plants of western Texas have led to the present supplementary paper.

The total area is 40,695 square miles, 16.5 per cent of the land area of Texas. We can differentiate five general geographic areas, viz.: (1) the mountain chains trending north-northwest, (2) the Edwards plateau, (3) the limestone-and-gypsum hill-and-plain area of Reeves and Pecos counties; (4) the deep sand eolian plains of Winkler, Ward, and Crane counties, and (5) the rugged, eroded, canyon area along the Rio Grande. Broadly defined and vaguely delineated floristic provinces have been discerned in western Texas. For example, Turner (1959), on the basis of distribution of Leguminosae, recognizes the southern portions of Presidio and Brewster counties as the northern part of the Chihuahuan desert, since many Chihuahuan species find theor northern limits in this "Big Bend" area. Our species of Croton, being mostly weedy and seemingly adapted to a latitude of conditions, do not reflect this provincial type of phytogeography, with the possible exception of C. abruptus. Two species, C. glandulosus and C. texensis, are apparently restricted to deep sandy soil, and their distributions reflect this edaphic restriction.

Johnston, M.C.; Warnock, B.H.

1962

The Four Kinds of Argythamnia (Euphorbiaceae) in Far Western Texas

The Southwestern Naturalist 7(2): 154-162, October 5, 1962

Keys, descriptions and notes on nomenclature, ecology and distribution are provided for the four taxa of Argythamnia in the trans-Pecos and adjacent counties of western Texas. Three species, one of them with two varieties, are recognized in this region. No new names or taxa are published.

Johnston, M.C.; Warnock, B.H.

1962

The Four Species of Acalypha (Euphorbiaceae) in Far Western Texas

The Southwestern Naturalist 7(3-4): 182-190, Dec. 10, 1962

Keys, descriptions, and notes on nomenclature, distribution and ecology are given for the four species of Acalypha (Angiospermae: Dicotyledonae) occurring in the trans-Pecos and adjacent counties of extreme western Texas. No new names or taxa are included.

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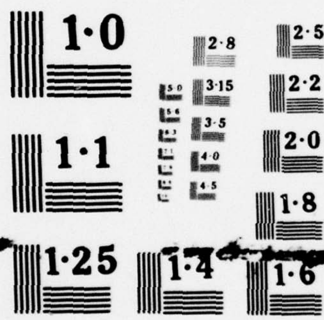

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Johnston, M.C.; Warnock, B.H.

1963

Phyllanthus and Reverchonia (Euphorbiaceae) in Far Western Texas

The Southwestern Naturalist 8(1): 15-22, May 10, 1963

Keys, descriptions, and notes on ecology and distribution are given for the species of Reverchonia and Phyllanthus occurring in the Trans-Pecos and adjacent counties of western Texas including Reverchonia arenaria, Phyllanthus abnormis, P. polygonoides, and P. ericoides, the latter not having been reported to occur in the United States. No new names or combinations are published.

Johnston, M.C.; Warnock, B.H.

1963

The Three Species of Stillingia (Euphorbiaceae) in Far Western Texas

The Southwestern Naturalist 8 (2): 100-106, July 31, 1963

Keys, descriptions, and notes on nomenclature, ecology, and distribution are given for Stillingia Treculiana, S. sylvatica, and S. texana of the trans-Pecos and adjacent counties. No new names or taxa are published.

Johnston, M.C.; Warnock, B.H.

1963

The Species of Cnidoscolus and Jatropha (Euphorbiaceae) in Far Western Texas

The Southwestern Naturalist 8(3): 121-126, Nov. 14, 1963

Keys, descriptions, and notes on nomenclature, ecology, and distribution are given for Cnidoscolus texanus, Jatropha dioica (with two varieties), and J. macrorhiza of the trans-Pecos and adjacent counties. No new names or taxa are published.

Jordan, Gilbert L., Maynard, Michael L.

1970

The San Simon Watershed: Shrub Control

Progressive Agriculture in Arizona, v.22 (5) :6-9

The San Simon Valley, a frail watershed in southeastern Arizona, is subject to excessive soil movement and arroyo formation as a result of mis-management, over-grazing and drought. This semi-arid region (less than 9.5 inches annual precipitation) is dominated by shrubs, mainly sand-dune mesquite, creosotebush and tarbush. Perennial grass cover is composed of sideoats, grams, black grama, bush muhly, spike and mesa dropseed, sacaton, Arizona cottontop, plains bristle-grass, and cane beardgrass. Vegetation improvement for erosion protection and increased forage production required shrub removal and grass planting. Shrub removal is necessary in semiarid rangelands because shrubs use limited moisture necessary for seedling establishment and germination. Brush control study sites were selected from typical cattle-grazed rangeland and were subsequently fenced. The Bowie site has creosotebush and sand-dune mesquite communities. The communities have extensive lateral root systems and deep tap roots, which collect windblown sand. The San Simon site has communities of sand-dune mesquite, creosotebush, tarbush, and four-wing saltbush. Seeding studies, mechanical shrub control and complete to moderate brush eradication were performed during the 1963 to 1966 period. Four-wing saltbush, a palatable browse plant, was not well controlled. Soil moisture was an important factor in brush control, since mechanical control tends to be more effective when moisture is low. Root and disk plowing and pitted chaining effectiveness is shown in two tables; six photographs show typical vegetation and shrub control techniques. (Popkin-Arizona)

Jordan, Gilbert L., Maynard, Michael L.

1970

The San Simon Watershed: Revegetation

Progressive Agriculture in Arizona, v.22 (6) :4-7

Reclamation of the eroded and frail San Simon watershed (Southeastern Arizona) is based on revegetation. Mechanical shrub control of creosotebush and sand-dune mesquite increases available soil moisture to native range grasses. Grass-reseeding and shrub-control studies were conducted to evaluate an optimum response balance under hot semi-arid conditions. There was no emergence of Lehmann lovegrass until summer rainstorms, regardless of planting time or spring rains. Lovegrass required tillage to yield, though chaining and pitting showed promise. Soil moisture and texture are discussed for grass yields. Precipitation distribution in time and amount is the key to effective land management. Of the 9.5 inches of annual rainfall, 58% (5.5 inches) occur randomly during the summer growing season. Plowed seedbeds of Lehmann lovegrass produce the most dependable yield. Research is continuing on effective plowing methods, seedbed manipulation through different pits, fungicide treatment of seeds, seed germination, selection and development of adopted grasses, and other factors useful in managing semiarid wildland. (Popkin-Arizona)

Joy, Charles R.; Helwig, Lawrence; Reiger, Theodore; Supola, Monte

1954

A Comparison of Grass Growth on Different Horizons of Three Grassland Soils

J. Range Management v.7 (5) :212

Association of plant production with soil quality has been generally recognized and tested on agricultural lands. Few studies of such relationships between soil conditions and plant growth have been made on range lands. Sinclair and Sampson (1931) have made an intensive study for a single soil series in California. The purpose of the present study was to evaluate the growth responses of two grasses grown on separate soil horizons of three grassland soils of western Montana.

Kearney, T. H.

1914

Indicator Significance of Vegetation in Tooele Valley, Utah

Journal of Agricultural Research 1 :365-417

No abstract available.

Kearney, T.H.; Cameron, F.K.

1902

Some Mutual Relations Between Alkali Soils and Vegetation

US Dept. of Agriculture Report 71, 78 p.

This paper describes experimental studies with various salts in pure and mixed solutions. Formation of black alkali and resistance to it by plants is treated. An extensive bibliography is included.

Keil, D.J.

1973

Vegetation and Flora of the White Tank Mountains Regional Park, Maricopa County, Arizona

Arizona Academy of Sci., J. 8(1):35-48

The White Tank Mountains are a small granitic mountain range rising above the desert plain about 20 miles west of Phoenix, Arizona. The vegetation of the White Tank Mountains Regional Park has been divided into five zones representing vegetational responses to different sets of environmental conditions: upper Sonoran Desert scrub, Alluvian Plain Desert scrub, desert grassland vegetation, sheltered sites vegetation, and wash channel vegetation. The known flora of the park consists of 332 species of vascular plants, representing 214 general in 66 families, displayed in a tabular catalog.

Kinraide, Thomas B.

1978

The Ecological Distribution of Cholla Cactus (Opuntia Imbricata (Haw.) DC.) in El Paso County, Colorado

The Southwestern Naturalist v.23 (1) :117-134

The range of Opuntia imbricata (Haw.) DC., together with data from 250 weather stations, was mapped revealing that the cactus is essentially confined to a region receiving 28 to 48 cm annual precipitation and experiencing mean January temperatures above -1°C. The distribution of the cactus was quantitatively mapped for El Paso County, Colorado, the northernmost county of its range. Here the cactus achieves greater densities upon soils of high clay content and upon areas of sloping and concave surface and southern aspect. An analysis of published data from New Mexico reveals a greater abundance of cholla upon fine textured soils in that state as well.

Individual plants are dispersed according to a Poisson distribution--at least within quadrats 4 to 100 m^2 in area. Within 25 m^2 quadrats the cactus associated positively, and significantly, with Sitanion hystrix, Hilaria jamesii, Muhlenbergia torreyi, and Yucca glauca. Negative associations were observed with nine species, most of which are commonly regarded as weeds or indicators of range deterioration. The quadrats were objectively segregated into several groups, and the species composition of each group has been tabulated. The successional status of Opuntia imbricata has not been established, nor has its status as a pasture pest been determined.

Kleiner, Edgar F., Harper, K. T.

1972

Environment and Community Organization in Grasslands of Canyonlands National Park

Ecology v.53 (2) :299

Sixty uniformly distributed stands in adjacent areas, 40 in Virginia Park (virgin) and 20 in Chesler Park (grazed), were analyzed by the point sampling method, and frequency by means of 25 quadrats (each 0.125 m^2) per stand. The prevalent species (26 in Virginia, 23 in Chesler) were selected on the basis of a constancy-times-frequency index. Interspecific association patterns were determined by means of simple correlation procedures based on quadrat frequency values for each species in the individual stands. Major environmental variables were recorded at each stand, and soil samples from four depths were collected at each site. Soil samples were analyzed for texture, bulk density, pH, organic matter, total nitrogen, and available K^+, $PO_4^{\equiv}$, and Ca^{++}.

Although the parks are similar in gross environment and vascular plant cover, cryptogamic vegetation and community structure differ markedly between the areas. Many vascular species occur in greater abundance in one park than the other. Floristically, Virginia was much richer than Chesler Park. Cryptogamic cover was about seven times greater in the ungrazed park. The lichen and moss ground cover is apparently important in stabilization of the highly erodable, sandy soils against wind and water erosion. Cryptogams also have an important influence on chemical characteristics of the surface 5 cm of soil, and the difference in surface soils between the parks may be related to the presence of these species. Community pattern in the virgin park is more definite than in the adjacent, grazed park, a condition which is contrary to the concept that minimum association between species (pattern) is to be expected in stable as opposed to successional vegetations.

Kleiner, E.F.; Harper, K.T.

1977

Soil Properties in Relation to Cryptogamic Groundcover in Canyonlands Nat'l Park

J. Range Management 30:202

A comparative study was made of the soils of a virgin grassland and adjacent grazed area in Canyonlands Nat'l Park. Soils from the virgin site were finer textured than those of the grazed area, and the surface 5 cm contains a significantly lower amount of calcium. In addition, the surface 5 cm of the virgin site contains significantly greater amounts of phosphorus, potassium, and organic matter. Subsurface soils in the two parks are less dissimilar. Cryptogams on the virgin grassland appear to have an important influence on chemical characteristics of the surface 5 cm of soil. The difference in surface soils between the parks may be related to the presence of these species. Data point strongly to light winter grazing as a disturbing influence that has contributed to the differences in the surface soil and in vegetational characteristics between the sites.

Kleiner, E.F.; Harper, K.T.

1977

Occurrence of Four Major Perennial Grasses in Relation to Edaphic Factors in a Pristine Community

J. Range Management 30(4):286

The ecology and phytosociology of a virgin grassland community (Virginia Park, Canyonlands Nat'l Park, UT) have been investigated. Based on the use of C x F index, Hilaria jamesii and Stipa comata are the most abundant of the four major perennial grasses. Oryzopsis hymenoides and Sporobolus cryptandrus are less abundant in decreasing order. The sites dominated by Hilaria are characterized by soils with finer texture, slightly warmer average temperature, and higher surface K+ and organic matter compared to sites dominated by Stipa comata. In addition, frequency of both vascular and cryptogamic species is greater on sites dominated by Hilaria.

Kramer, P. J.

1944

Soil Moisture in Relation to Plant Growth

Botanical Review 10(9) :525-559

This general review of literature on soil moisture covers conditions of desert environment and includes very useful information on the relation of soil moisture to plant growth. Includes a bibliography of 108 titles.

Lesueur, H. D.

1945

Ecology of Vegetation of Chihuahua, Mexico, North of Parallel 28

University of Texas, Austin, Publication 4521, 92 p.

This very thorough discussion of the vegetation north of 28°N latitude includes a vegetation map.

Lindsey, Alton A.

1951

Vegetation and Habitats in a Southwestern Volcanic Area

Ecological Monographs v.21 (3) :227

Table of Contents

One of the most extensive and least known areas of recent volcanism in this country lies east of the continental divide in west-central New Mexico. The various flows occur largely in Valencia and McKinley counties. Extending northeast-southwest for more than a hundred miles, the area's length is nearly equally bisected by the Rio San Jose at Grants. Most of the extrusive material of the general region is considered late Tertiary (Dutton 1886; Darton 1928). Hooper (1941) has published a brief general description of the physiography and geology in and about the lava area. He also gave more detailed descriptions of his various stations for collecting mammals.

In the present study emphasis was centered on an area of 220 square miles southwest to east of Grants, shown within the solid line and the northeast dashed boundary of Figure 1. The junction of the meridian of 108^{o} W. and the parallel of 35^{o} N. falls not far north of the main body of this lava flow. The map was prepared from airphoto mosaic sheets on which the distinct black shade indicates largely the Quaternary, probably

mostly Recent, lava. This material is rough and unweathered, showing very little soil accumulation; the youngest portion is believed to have flowed very recently, possibly within historic times. The area near Grants outlined by a dashed boundary is distinctly older than the narrow tongue adjacent to it farther east. These flows partly overran much weathered lava of Tertiary age, which appears light on airphotos because of its soil mantle of windblown silt, or of pumice from nearby cones. The large flat plain south of the continental divide where volcanic peaks dot the map, is of Tertiary lava covered largely with aeolian deposits. In the broad body of the flow appears a large, roughly triangular area of the same nature, which the recent flows failed to cover. The general highway map of Valencia County prepared by the New Mexico Highway Department (1938) omits many of these features.

The dark gray or black, sometimes reddish, younger basalt forms a conspicuous scenic feature popularly called the "malpais." A number of color photographs of this lava bed's scenery were published by Clark (1946) in a popular magazine article. This malpais has been called the "Grants Lava Bed," the "McCarty's Lava," and the "Aqua Fria Malpais" by different writers. It is general practice to use the name of the nearest town, Grants, for the 220 square mile deposit of largely Quaternary lava, instead of restricting the name, as Hooper did to a small portion of the flow nearest Grants.

Little, E. L.

1950

Southwestern Trees, a Guide to the Native Species of New Mexico and Arizona

U. S. Department of Agriculture, Agriculture Handbook 9 :1-109
BA 25(10)31771

This handbook includes descriptions and drawings of the principal trees of Arizona and New Mexico. Gives data on distribution and principal vegetation types are tabulated and mapped. An excellent reference for the identification of woody plants.

Livingston, B.E.

1906

The Relation of Desert Plants to Soil Moisture and to Evaporation

Carnegie Inst. of Washington, Publ. 50, 78 p.

Describes relations between desert plants and their physical environment (i.e., soil and atmosphere) based on research done at the Desert Laboratory, Tucson. Includes a detailed discussion of soil, its character, water content, permeability, water retention, etc. Atmospheric studies focus primarily on evaporation. Plant autecology studies deal with water requirements of certain desert plants, and osmotic pressure of cactus juices. Some data are presented on water requirements for germination and growth of Saguaro.

Livingston, B.E.

1910

Relation of Soil Moisture to Desert Vegetation

Botanical Gazette 50:241-256

The nature of the root system and soil moisture content determine water supply as the evaporating power of the air and the nature of the transpiring organs nearly determine the water requirements of plants. Soil moisture depends on the rate of influx and the rate of removal of water from the soil. Soil types of the area studied include a heavy clay, a limestone hardpan (Caliche), washes varying from gravel through sand to very loamy sand, and clay loam. The plant societies studied include the Parkinsonia society of Tumamoc Hill, a Larrea society accompanied by Ephedra, Cercidium torreanum society, and a Prosopis society. The degree of soil moisture lage behind precipitation. The period of most intense drought occurs just before the beginning of the summer rains. June is the month of driest soils and also the month of greatest evaporation. The water-holding capacities and water content of the soils and vegetation of the several areas discussed are correlated. Hill soils seem to be best suited for general plant activities, the plain second-best, and the other two, wash and river floodplain, last and much less suitable. The water-holding power of soil is a very important factor in studies of distribution.

Livingston, R.B.

1949

An Ecological Study of the Black Forest, Colorado

Ecological Monographs, V.19, No.2

Contents

Adjunct communities of the montane forest of the Rocky Mountains occur eastward across the Great Plains far into Nebraska (Pound & Clements 1900). One of the largest of these communities, known as the Black Forest of Colorado, occurs near the mountains on the upper portion of the divide which separates the South Platte and Arkansas rivers. The causal factors permitting this and similar extensions of the coniferous forest into the mixed prairie grasslands have not been well established. Knowledge of the factors which permit the establishment and survival of these communities in semi-arid grassland regions should be of practical use as a tool in the evaluation of sites for afforestation or shelter belt plantings.

The purpose of this study, which was undertaken in the Black Forest region, was to:

1. Analyze these arborescent communities for composition;
2. Determine the relationships of arborescent and grassland communities to climatic and edaphic factors;
3. Study the trends of secondary succession in the forest; and,
4. Learn whether the limits of the forest are static or manging.

These studies were to be made in order to learn if possible why the Black Forest occurs as it does, as an area otherwise dominated by mixed prairie vegetation.

Lotspeich, Frederick B.; Everhart, Marion E.

1962

Climate and Vegetation as Soil Forming Factors on the Llano Estacado

J. Range Management v.15 (3) :134

Although most of the Llano Estacado is devoted to field crop production, some of it is still used as native ranges for livestock. The floristic composition of these ranges is sensitive to small differences in soil, especially texture, and aspect associated with the large number of depressions of this featureless plain. An understanding of the native plant communities and the associated soils of these ranges assists both range and soil scientists in managing them. This paper describes the broad features of the vegetation and climate of the area and relates them to the soils.

Lunt, D.R.; Letey, J.; Clark, S.B.

1973

Oxygen Requirements for Root Growth in Three Species of Desert Shrubs

Ecology 54(6):1356-1362

High oxygen requirements for root growth are found in shrubs of Artemisia tridentata and Larrea tridentata. Roots of Franseria dumosa, like many economic plants, need lesser amounts of oxygen. A comparison of oxygen diffusion rate among the three shrubs shows that 0.30 mg/cm^2 per min.^{2} is required by Franseria to achieve a root growth rate that is 50 percent maximum at the experimental temperatures with Artemisia about 0.50 and Larrea about 0.43. It is concluded that due to high oxygen requirements for root growth, Larrea and Artemisia are excluded from fine-textured and poorly drained soils in the desert.

Lutwick, L.E.; Dormaar, J.F.

1968

Productivity of a Soil Biosequence of the Fescue Prairie-Aspen Transition

J. Range Management 21:24

Grassland soils have some quality that enables plants to respond to P fertilizer. This quality deteriorates when poplar trees advance on rangelands; it is completely destroyed when coniferous trees become the dominant vegetation. Clearing of trees and seeding of grass returns some grassland character to soil. If soil organic P is considered an index, NP fertilizers, along with the grass, are expected to hasten the return of the grassland character.

Lyford, F.P.; Qashu, H.K.

1969

Infiltration Rates as Affected by Desert Vegetation

Water Resources Res. 5(6):1373-1376

Infiltration of water into two soils measured at radial distances from the stems of Paloverde (Cercidium microphyllum) and creosote bush (Larrea tridentata) averaged nearly three times greater under plants than in the openings. Bulk density was lower and organic matter content was higher in topsoil under plants than in the openings.

Lynch, Brother Daniel, C. S. C.

1962

Study of a Grassland Mosaic at Austin, Texas

Ecology v.43 (4) :679,686

A mosaic of two grassland communities occurs as a relict of roughly 8 acres adjacent to St. Edward's University in Austin, Travis County, Texas. The relict lies at the western edge of the Andropogon-Stipa Association of Tharp which comprises the Black and Grand Prairies (Tharp 1926), the Fort Worth Prairie, which is the northern part of the Grand Prairie (Dyksterhuis 1946), and the San Antonio Prairie (Launchbaugh 1955). The relcit is located 3.1 kilometers (1.7 miles) southwest of the Colorado River and within the Balcones Fault Zone which forms the eastern front of the Edward's Plateau (Hill and Vaughan 1902). Little bluestem (Andropogon scoparius Michx.) is the dominant grass in one community, and red three awn (Aristida longiseta Steud.) shares dominance with forbs in the other. Live oak (Quercus virginiana Miller) and cedar (Juniperus Ashei Bucholz) form groves or grow singly where the soil is thin, and mesquite (*Prosopis jubiflora var. glandulosa* (Torr.) Cockerell) is thinly scattered on deeper soil. The relict lies within the ecotone between the Andropogon-Stipa Association and the woodland of the Edward's Plateau. The Andropogon-Stipa Association ends "abruptly along the Balcones Escarpment which south of the Colorado River sharply delimits the abrupt junction of the prairie and the oak-cedar-mesquite woodland. . . .Contact with the cedar-oak-mesquite south of the Colorado River is abruptly through live oak both in open stand and in mottes, and through open mesquite" (Tharp 1926).

Two communities, one dominated by Andropogon scoparius and the other by Aristida longiseta and forbs, form a mosaic on a Rendzina at Austin, Texas. Frequency data taken on 9 days at intervals varying from 4 to 8 weeks over a 1-year period show an average species correlation over the year of 0.24 between the two communities. Soil depth to limestone averages 7.6 decimeters in the Aristida community and more than 16 decimeters in the Andropogon. Soil moisture percentages taken at about bi-weekly intervals show that the Aristida is the more xeric of the two communities and that soil moisture in this community goes below the permanent wilting percentage during July and August. Phenological data taken at weekly intervals correlate well with soil moisture during a 1-year period. A. scoparius forms a dense stand in the Andropogon community and appears to prevent the invasion of species not tolerant of shade and crowding. The shallowness of the soil and the smaller amount of soil moisture available for plant growth in the Aristida community apparently prevent the establishment of scoparius.

Lynch, Brother Daniel, C. S. C.

1971

Phenology, Community Composition, and Soil Moisture in a Relict at Austin, Texas

Ecology v.52 (5) :890

Two plant communities, one dominated by Andropogon scoparius Michx. and the other by shorter grasses and forbs, have changed considerably in floristic composition and areal coverage since the end of the 1950-56 drought. A phenological study at the end of the drought indicated a direct relationship between percentage of species vegetative and reproducing and percentage of soil moisture. A second study after 4 years of above-normal precipitation showed no such relationship. The total number of species in an exclosure encompassing both communities was relatively unchanged after 4 years of above-normal precipitation, although the species turnover was 37%. Frequency data from 40 permanent plots, 20 in each community, showed a species turnover of 85.5% in the plots in the Andropogon community and 91.7% in those in the grass and forb community during the 5-year period from 1958-59 to 1963-64. The total number of species in the plots, however, remained relatively unchanged. The years of above-normal precipitation resulted in the invasion of the grass and forb community by A. scoparius and the replacement of the dominant grass, Aristida longiseta Steud., in the remainder of the community by Trisetum interruptum Buckl. and Sporobolus vaginiflorus (Torr.) Wood. The position of the ecotone between the two communities at the end of the drought and the path of A. scoparius invasion appear to be a function of soil moisture as affected by soil depth. The soil in ghe Andropogon community to a depth of 6 dm is more moist at almost all times of the year than that in the grass and forb community. At the end of the drought A. scoparius occupied soil 9 dm or more deep. With succeeding years of above-normal precipitation it invaded the grass and forb community along a gradient of decreasing soil depth.

Macdougal, D.T.

1908

Botanical Features of North American Deserts

Carnegie Inst. of Washington, Publ. 99, 111 p.

This study presents a comprehensive examination of the Xerophytic and other highly specialized plant forms characteristic of the North American deserts. Analyzing results of investigations made at the Desert Laboratory, Tucson, Macdougal includes data on the characteristics of the various North American desert regions, geological, and meteorological aspects, vegetation, temperature, water relations, and soil relations of desert plants. Reissued in 1971 by Johnson Reprint Corporation, New York, NY.

Mace, A. C., Jr.

1970

Osmotic Water Stress: Mesophyll Saturation Deficit and Transpiration Rates of Tamarisk

Southwestern Naturalist, v.16 (1) :117-120

Tamarix Pentandra Pall. exists and thrives under a wide range of saline conditions that prevent establishment and growth of other species. This may be due to an adaptation for exuding salt through salt glands, thereby reducing solute concentration at the evaporating surface. However, this mechanism has not been isolated and its effect on transpiration rates under high saline conditions is unknown. Estimates of the mesophyll saturation deficit were determined, on the assumption that at zero transpiration the vapor pressure of the evaporating surface of the mesophyll cells was in equilibrium with that of the atmosphere and that stomatal resistance was constant. These estimates indicate that salt accumulation at the evaporation surface of the stomatal cavity is small and little affected by increasing root substrate salinity. Salt glands do provide a mechanism for salt excretion, which if concentrated at the evaporation surfaces, would reduce transpiration rates. High saline content reduced transpiration rates only at high vapor pressure deficits where other resistances within the plant may be affected. (Casey-Arizona)

Magistad, O. C.

1945

Plant Growth Relations on Saline and Alkali Soils

The Botanical Review, v.11 (4) :181

Serious study of saline and alkali soils and their relation to plant growth was begun by Hilgard (125) before 1886 and later summarized in 1900 (126) and 1906 (127). It received a mighty impetus with the work of Gedroix (78, 79, 80, 81, 82, 83), de Sigmond (297, 298, 299, 300, 301, 302, 303, 304, 305, 306), Kelley (164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179) and Hissink (128, 129, 130, 131, 132, 133, 134, 135) who all demonstrated that alkali soils differ from normal soils in maintaining abnormal quantities of replaceable sodium. Harris (99), in his book in 1920, reviewed the subject of alkali soils, but this was prior to a general knowledge of base exchange in soils and many recent advances in plant physiology.

Marchand, Denis E.

1973

Edaphic Control of Plant Distribution in the White Mountains, Eastern California

Ecology v.54 (2) :233

Vegetation in a part of the southern White Mountains is primarily distributed according to geologic substrate, although superimposed trends controlled by climatic, microclimatic, and topographic gradients are also evident. Carbonate-noncarbonate discontinuities are the most striking, but distinct plant assemblages on basalt, adamellite, and sandstone are also recognizable. Certain species, chiefly but not entirely those associated with the more favorable noncarbonate substrates, occur independently according to nutrient, moisture, temperature, or root-stability requirements. Lupinus argenteus, a strict calcifuge, was found to require high available P. and to a lesser extent, high available Fe. Many species occur on carbonate substrates, unstable slopes, and other unfavorable sites because of competitive exclusion imposed by more tenacious species, especially sagebrush. The principal adverse properties of carbonate soils are chemical (low available P and Fe, low percentage exchangeable K, high pH) and, secondarily, thermal (low soil temperature caused by high albedo). A number of other unevaluated factors must be involved in the observed vegetational patterns, however. Factor analysis of edaphic, geographical, and botanical parameters indicates many associative and mutually exclusive relationships which may provide an informational basis for future investigations.

Marks, J.B.

1950

Vegetation and Soil Relations in the Lower Colorado Desert

Ecology 31(2):176-193

Plant communities in a desert area of southwest Arizona and southeast California are described and related to the salinity, pH, and moisture-holding capacity of the soil. The valleys, mesas, bajadas, and mountains are described with their characteristic soil types and vegetation. Valleys show the greatest variety of vegetation; four communities are described, dominated respectively by Prosopis juliflor, by Pluchea sericea and Tamarix gallica, by Atriplex spp., and by salt shrubs Allenrolfea occidentalis or Suaeda torreyana. The Larrea-Franseria Association is described for the mesa, together with its subcommunities, and one community dominated by Fouquieria splendens and various cacti is described on the Bajada. In these communities, soil samples collected were tested for moisture retention and for percent of soluble salts. The Atriplex and Pluchea-Tamarix communities are the least saline in the valley, while Prosopis, Suaeda, and Prosopis-Atriplex communities are significantly more saline than these; the Allenrolfea community is significantly the most saline of all. Moisture retention data show increasing moisture-holding capacity of soils indicated by the Acacia greggii and Coldenia palmeri, the Dalea emoryi and Opuntia leptocaulis, the Fourquieria and the Larrea-Atriplex communities.

Mason, L.R.; Andrews, H.M.; Carley, J.A.; Haacke, E.D.

1967

Vegetation and Soils of No Man's Land Mesa Relict Area, Utah

J. Range Management 20:45

On No Man's Land Mesa, a relict area in Kane County, Utah, two distinctly different soils were found which produce significantly different kinds and amounts of vegetation. The Upland sand (Pinon-Juniper) site yielded an average of about 1100 lb/acre airdry comprising 10 percent grass, 5 percent forbs, and 85 percent trees and shrubs. The Upland shallow breaks (Pinon-Juniper) site yielded an average of nearly 800 lb/acre comprising five percent grass, five percent forbs, and 90 percent trees and shrubs.

McColley, P.D.; Hodgkinson, H.S.

1970

Effect of Soil Depth on Plant Production

J. Range Management 23:189

Soil depth is an important factor to consider when evaluating forage production on range soils. Three soils with different soil depths produced different kinds and amounts of vegetation. The Bakeover cobbly silt loam (5 in. to basalt bedrock) produced 158.7 lb/acre. The Anders silt loam (25 in. to basalt bedrock) produced 869.4 lb/acre.

McGinnies, W.G.

1955

A Report on the Ecology of the Arid and Semi-Arid Areas of The United States and Canada, In Plant Ecology, Reviews of Research

Unesco, Paris, France, Arid Aone Res. 6:250-301

A review of the literature relating to physical features of arid and semi-arid areas, major plant communities, physiographic factors, climatic factors, ecological effects of grazing and clipping, fire ecology, plant succession, and broad ecological applications. A 43-page bibliography.

McKell, C. M., Goodin, J. R.

1966

Improvement of Soil Moisture in the Conversion of Chaparral to Grass

Proc. 9th International Grassland Congress (1) :573-575

Experimental plots were established to follow soil moisture changes in the root zone of vegetation cover in Southern California. The first site was on a northeast slope supporting chamise and oak. The second site was on north, south, and east facing slopes and supported a cover of chamise and oak. At the first site, the 12 inch depth of soil showed the most erratic changes in moisture levels. Rapid wetting and drying cycles corresponded closely with occurring rainfall. A major factor in successful establishment of a new vegetation cover lies in moisture accumulation and conservation until the seedling is firmly enough established to draw upon moisture reserves of a large soil volume. If native grasses are not present, removal of the overstory allows for an accumulation of soil moisture required for a successful program of range seeding. Correct timing with respect to rainfall and complete removal of the overstory are needed in arid areas in order to let native grasses make most efficient use of the moisture available to them. (Blecker-Ariz)

McKelvey, S. D.

1938-1947

Yuccas of the Southwestern United States

Harvard University, Arnold Arboretum, 2 vols.

A comprehensive review of the yuccas of the southwestern United States, including California, Arizona, New Mexico, Texas and Utah. Includes distrubition maps for each of the species described.

McLean, Alastair

1970

Plant Communities of the Similkameen Valley, British Columbia, and Their Relationships to Soils

Ecological Monographs, v.40 (4) :403-424

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192-A

Five vegetation zones were recognized in the Similkameen Valley of southern British Columbia. These zones were largely controlled by elevation primarily as a reflection of climate. The climate becomes progressively more moist from east to west and with increasing elevation. Two habitat types were described in the Artemisia tridentata zone, three in the Pinus ponderosa zone, five in the Pseudotsuga menziesii zone, five in the Abies lasiocarpa zone, and one in the Alpine zone. Some habitat types correlated well with the soils at a great group level. The Pinus-Festuca habitat type was found mostly on Dark Gray soils, the Pseudotsuga-Festuca habitat type on a variety of soils, the Pseudotsuga-Calamagrostis habitat type on Gray Luvisols, the Festuca-Eriogonum habitat type on Black Chernozems, the Abies-Vaccinium-Calamagrostis habitat type on Dystric Brunisols, and the Abies-Vaccinium, Phyllodoce habitat type on Alpine Dystric Brunisol soils. A key for the identification of the major habitat types is included.

McMinn, Robert G.

1952

The Role of Soil Drought in the Distribution of Vegetation in the Northern Rocky Mountains

Ecology v.33 (1) :1

In regions of wet winters and dry summers especially, the soil acts as the reservoir supplying water to the plants during the growing season. The amount of growth-water held by the soil is set by the field capacity as the upper limit and the permanent wilting percentage as the lower limit. This growth-water is supplied as rain during the wet season, and where it is not maintained during the dry season by ground water, the supply of growth-water is gradually exhausted. The rate of use and the time of exhaustion depends on such factors as the date of the onset of severe transpiration stress, its daily duration and intensity, and upon the plant cover.

The effect of this soil moisture relation on the distribution of species depends on the plants concerned. It has been shown by Daubenmire (1943) that certain mesophytes (tree seedlings) can withstand dry air, provided there is adequate soil moisture. On the other hand they died after relatively short periods when soil moisture was reduced to the permanent wilting percentage. Annuals may flourish early in the season when the upper layer of the soil is still wet and spend the dry season as seeds. Perennial herbs may either keep in contact with moist subsoil or aestivate. Those seedlings which cannot aestivate, must have sufficiently fast growing root systems to keep ahead of the progressive desiccation or they will be eliminated from areas where soil drought occurs.

McNaughton, S. J.

1968

Structure and Function in California Grasslands

Ecology v.49 (5) :962

Functional and floristic properties of annual grasslands on serpentine and sandstone soils at an elevation of 180 m on Stanford University's Jasper Ridge were determined along an intuitive habitat gradient from northeast to southwest exposures. The most frequent species contributed the most to peak standing crop in only half the stands. Stipa pulchra, the only native species among the important species, was more important on serpentine than on sandstone sites. Bromus mollis, the other consistently important species, increased in importance with decreasing moisture supply on both soils. The sandstone grasslands sustained a greater biomass, were more productive, and were less diverse than serpentine grasslands. Within the grasslands as a whole, productivity was inversely related to neither productivity, diversity, or dominance. Thus productivity may increase in such a system with no sacrifice in stability. Properties of sandstone grasslands were clearly related to the habitat gradient from cool, moist sites to warm, dry sites. There was no such relationship in serpentine grasslands. Dominance-diversity curves generally fit previously described models, except on southwestern serpentine exposures. The annual grassland vegetation is a mosaic of floristic composition and ecological properties, shifting in response to habitat patterns but without abrupt discontinuities.

McPherson, James K., Muller, Cornelius H.

1969

Allelopathic Effects of Adenostoma Fasciculatum, "Chamise", in the California Chararral

Ecological Monographs v.39 (2) :177-198

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Chararral vegetation characterized large areas of the mountain slopes of central and southern California and Baja California. It is developed on substrata derived from a wide variety of parent materials including, but not limited to, sandstone, shale, granite and various metamorphic rocks. Soils are typically shallow, rocky and poorly developed on the moderate to steep slopes where chararral occurs. The climate is a Mediterranean one, with relatively mild temperatures throughout the year, a rainy season in winter and early spring, and a long, dry summer and fall.

The dominant species of the chaparral are shrubs with hard woody stems and evergreen, sclerophyllous leaves. Together, these shrubs form aspects varying from dense, impenetrable thickets to low, open stands, depending upon local physiographic, edaphic, and micro-climatic conditions. Of the many shrub taxa present, Adenostoma fasciculatum (Rosaceae) is the most common

195-A

and often forms pure stands. Mature chaparral usually lacks a significant herbaceous flora, this tendency being especially pronounced in A. fasciculatum stands (Figs. 1 and 2).

A monographic treatment of the broad-sclerophyll vegetation, emphasizing chararral, by Cooper (1922) remains definitive in most respects today. He included information on the climatic relations, habitats, and geographic affinities of the vegetation, as well as descriptions of the phenology and morphology of the major species.

Meinzer, O. E.

1926

Plants as Indicators of Ground Water

Washington Academy of Sciences, Journal 16(21) :553-564
BA 1(6)8697

The term "phreatophyte" is used to designate a plant that habitually obtains its water supply from a zone of saturation. This paper briefly reviews the history of the subject; gives evidence of phreatophytic habitat; discusses relations of these plants to hydrophytes, halophytes, xerophytes, and mesophytes; and discusses their value as indicators of the occurrence, depth, quality, and quantity of ground water.

Meinzer, O. E.

1927

Plants as Indicators of Ground Water

U. S. Geological Survey, Water-Supply Paper 577 :1-95

This elaboration of his 1926 paper includes 8 maps of arid regions showing the distribution of certain species in belts with specified depths to the water table.

Merkle, John

1954

An Analysis of the Spruce-Fir Community on the Kaibab Plateau, Arizona

Ecology, v.35 (3) :316

During the summer of 1951, sociological data were obtained in the spruce-fir forest on the Kaibab Plateau of northern Arizona. The area of study includes the highest elevations in Arizona north of the Grand Canyon of the Colorado River. The study was limited to the area inside Grand Canyon National Park because of its virgin condition. The area in the Kaibab National Forest to the north is utilized for grazing by livestock.

The past work on the spruce-fir forest has recently been extensively treated by Oosting and Reed (1952) in connection with the analysis of this type of community in the Medicine Bow Mountains of Wyoming. They also present an extensive bibliography.

The Kaibab Plateau is the highest of several in the Grand Canyon section with an altitude ranging from 7500-9200 feet. The southern part of this and adjacent plateaus bordering Grand Canyon on the north side are commonly known as the North Rim. The plateau is capped by the Kaibab limestone, which is maturely dissected by rounded valleys of gentle slope not more than 300 or 400 feet deep. These valleys are streamless despite the ample rains in summer and snows in winter (often over 10 feet) due to seepage into the highly porous limestone. Some springs are found and there are small sinks with ponds of fresh water (Fenneman 1931). The rock is composed chiefly of gray, crystalline and cherty limestone, but includes some beds of calcareous sandstone. Also there are local redbeds of crumbly fine sand and silt (McKee 1938). The soils are derived from the Kaibab limestone and are included in one of the areas of the Helmer-Santa-Benewah series of gray-brown podzolic soils (Ableiter, et al. 1938).

Merriam, C. H.

1893

Notes on the Distribution of Trees and Schrubs in the Deserts and Desert Ranges of Southern California, Southern Nevada, Northwestern Arizona, and Southwestern Utah

North American Fauna 7 :285-343

No abstract available.

Merriam, C. H.

1893

Notes on the Geographic and Vertical Distribution of Cactuses, Yuccas, and Agave, in the Deserts and Desert Ranges of Southern California, Southern Nevada, Northwestern Arizona, and Southwestern Utah

North American Fauna 7 :345-359

One of the earlier publications on the subject. Notes the characteristics of various plants and gives their distribution, including general range and specific local occurrences.

Meyer, Edw ard R.

1975

Vegetation and Pollen Rain in the Cuatro Cienegas Basin, Coahuila, Mexico

The Southwest Naturalist v.20 (2) :215-224

The Cuatro Cienegas Basin is a desert valley in central Coahuila, Mexico. The basin floor bears many aquatic habitats and supports a complex mosaic of edaphically-controlled vegetation communities. Spatial distribution and species composition of the communities are controlled by available soil moisture and soil salinity. Reparian sites support dense stands of sedges and cattails. Drier locations peripheral to riparian habitats support an extensive grassland community. Playas, stabilized dunes and other extremely dry areas bear a xerophytic community characterized by certain halophytic chenopods. Control by local vegetation over composition of pollen rain in the basin floor is extreme, and local pollen rain is dominated by grass, Chenopodiaceae-Amaranthus and aquatic pollen types. Fluctuations of proportions of those pollen types characterize pollen rains on the edaphic communities.

Miles, S. R., Singleton, P. C.

1975

Vegetative History of Cinnabar Park in Medicine Bow National Forest, Wyoming

Soil Sci. Soc. Amer. Proc., V.39 :1204

A study was initiated to determine the vegetative history and boundary stability of Cinnabar Park, a small park located in Medicine Bow National Forest, Albany County, Wyoming, typical of many high altitude parks scattered throughout our National Forest Lands.

The park and the forest immediately surrounding the park occur on an erosional remnant of uplifted Tertiary aged sediments at an elevation of 2,750 m. The soils of the park are classified as Cryoborolls, and those of the forest surrounding the park are Cryochrepts. Vegetation in the park consists of a variety of forbs, shrubs, and grasses, while that of the surrounding forest is mainly lodgepole pine (Pinus contorta Dougl.), with some Engelmann's spruce (Picea engelmanni (Parry) Engelm.) intermixed.

Various soil characteristics of the park were compared with those of the surrounding forest in an effort to obtain clues which might point to the vegetative history of this area. The content of plant opal and the pH of the soils, together with field observations, led to the conclusion that the park boundaries are slowly shifting in an eastward direction. Strong prevailing westerly winds and drifting snow appear to be the forces responsible for the boundary movement.

Mitchell, John E., West, Neil E., Miller, Raymond W.

1960

Soil Physical Properties in Relation to Plant Community Patterns in the Shadscale Zone of Northwestern Utah

Ecology v.47 (4)

Physical properties of soils associated with monospecific communities of Eurotia lanata and Atriplex confertifolia were studied to determine their possible influence on the vegetation pattern. Complete homogeneity of all properties examined indicated a lack of genetic soil variability as a cause of community differentiation.

Moir, William H.

1966

Influence of Ponderosa Pine on Herbaceous Vegetation

Ecology, v.47 (6) :1045

Field and experimental data from Spokane, Washington, suggest that ponderosa pine clusters past the seedling stage adversely modify the herbaceous environment during their subsequent development. Indications of herb suppression appear early in the development of pine clusters, especially in the dense sapling stages. Increased light interception by the pine canopies and the poorer soil nitrogen supply under trees act together in bringing about a decline in herb populations. This decline is first indicated by reduced inflorescence production of grass species and later by lessened canopy coverage of the ground vegetation. Continued tree development unchecked by fire or artificial thinning appears to lead toward total or near-total herb suppression.

Mooney, H. A.

1966

Influence of Soil Type on the Distribution of Two Closely Related Species of Erigeron

Ecology v.47 (6) :950

On soils derived from a uniform bedrock two closely related species of Erigeron replace each other elevationally in the White Mountains of California. Populations of the two species occur side-by-side at places at the same elevation but on dissimilar soils because of compensations provided by the interactions of substrate color, temperature, moisture, and chemistry. The altitudinal distribution of the species is controlled by temperature at the upper limits and moisture at the lower.

Morrow, Marie Betzner

1931

Correlation Between Plant Communities and the Reaction and Micro-Flora of the Soil in South Central Texas

Ecology v.12 (3) :497

The occurrence of vegetation areas differing significantly from the general vegetation area in which they are found, and from each other, thereby making climatic factors appear not critical, prompted an ivnestigation of the soil factors in certain of these areas. According to Clements ('20), every plant is a measure of the conditions under which it grows, and every habitat is a complex in which the the factors are almost inextricably interwoven. The first factors to receive attention were soil reaction and micro-flora. These, and other soil factors, together with their interrelationships, are under further investigation. The present account has to do with the soil reaction, the numbers and distribution of micro-floral groups, and the occurrence of higher plant communities.

Mueggler, W. F., Harris, C. A.

1969

Some Vegetation and Soil Characteristics of Mountain Grasslands in Central Idaho

Ecology v.50 (4) :670

Vegetation and soils were evaluated on 23 relatively undisturbed grasslands scattered throughout the mountainous region of central Idaho. Analyses by ordination and cluster techniques suggest existence of at least two classifiable communities: (1) the Agropyron-Melica community, which includes an abundance of native annuals and relatively few perennial species; and (2) the Festuca-Agropyron-Antennaria community, which includes few annuals but numerous perennials, among which mat-forming species are conspicuous. Several of these grasslands were considered transitional. Some site characteristics differed considerably between the two communities. Herbage production varied greatly; it was greatest on north exposures and on soils having high water-holding capacity. Production of grasses and sedges generally doubled that of forbs. Shrubs were a minor component.

Mueller-Dombois, D., Sims, H. P.

1966

Response of Three Grasses to Two Soils and a Water Table Depth Gradient

Ecology v.47 (4)

Three grasses--Calamagrostis canadensis, Audropogon gerardi, and Koeleria cristata--were grown for 13 months on two soil slopes in a greenhouse. One slope was composed of sand and the other of loamy sand; ranging from dry to wet. All three grasses were seeded uniformly over each tank. Competition was limited as each grass found its own niche above- and below-ground. Some interspecific competition resulted from shading by Koeleria, while the density of Calamagrostis was reduced by intraspecific competition on the better soil (loamy sand) and where the moisture level was most favorable. The density of Andropogon was the greatest on the loamy sand and reached its maximum at a very moist site on both soils. Koeleria produced its maximum shoot weight at a greater depth to water table than either of the other two species. During the final month of the study watering was discontinued and a more natural pattern resulted as Calamagrostis died back to the moist sites while Koeleria was able to survive at drier levels. Roots of each species occupied a different soil stratum, with Calamagrostis having the least flexible root system and Koeleria exhibiting a very flexible root system which readily adjusted to decreasing moisture supply.

Munn, L. C., Nielsen, G. A., Mueggler, W. F.

1978

Relationships of Soils to Mountain and Foothill Range Habitat Types and Production in Western Montana

Soil Sci. Soc. Mn. J.42 :135

Soils at 23 sites representing eight western Montana mountain and foothill range habitat types were characterized and classified in accordance with Soil Taxonomy. The soils ranged from Borollic Calciorthids at the dry end of a moisture and soil development gradient to Pachic Cryoborolls on the moist end. Corresponding vegetation was a Stipa comata-Buoteloua gracilis community on the dry end and a Festuca idahoensis-Agropyron caninum community on the moist end. Soil taxonomic units and vegetation habitat types were ordered along the moisture gradient. Multiple linear regression analysis was used to model above-ground dry-matter productivity of the sampled sites. Eighteen significant variables were identified including thickness of the mollic epipedon, total soil organic matter, total N content, elevation, depth to free carbonates, estimated annual precipitation, aspect, solum thickness, summer soil temperature at 50 cm, percent coarse fragments in the A horizon, and extractable K. The thickness of the mollic epipedon was the variable most highly correlated with productivity (r=0.89**) and the best regression model accounted for 90% of the variability in total productivity between sites (based on 2 years' productivity data). Soil morphological characteristics proved more useful in models of site productivity than estimated climatic data or site nutrient date.

Munz, P. A.; Keck, D. D.

1949

California Plant Communities

El Aliso 2(1) :87-105

The authors discuss a tentative classification of California plant communities into 5 provinces, 14 major vegetation types, and 24 communities according to dominant species and climatic conditions. The Nevada division includes a desert scrub, divided further into sagebrush scrub and shadscale scrub. The southern desert includes a desert scrub, divided further into shadscale scrub and creosotebush scrub. In a later publication the authors classed all scrub types under one major scrub type.

Munz, P. A.; Keck, D. D.

1950

California Plant Communities; Supplement

El Aliso 2(3) :199-202

The previous classification was revised from 24 to 28 plant communities. The authors consolidated all scrub under one vegetation type, including northern coastal scrub, coastal sage scrub, sagebrush scrub, shadscale scrub, creosotebush scrub, and alkali scrub. The term "scrub" may adequately describe the vegetation found in California, but it is hardly an adequate term to describe the more luxuriant vegetation of the Sonoran and Chihuahuan deserts.

Murbarger, N.

1950

The Great White Sands

Natural History 59(5) :228-235 BA 25(2)3761

This 200-square mile area includes dunes composed of 99 per cent pure gypsum crystals completely devoid of nitrogen. The 62 species of plants growing in this area have their roots in the stabilized flats, either beneath or between the dunes. Yucca shows the greatest adaptability. The plants occurring on the flats between the dunes are discussed, and also the animal population of the area.

Nash, Thomas H., III, Zavada, Michael

1977

Population Studies Among Sonoran Desert Species of Parmelia Subg. Xanthoparmelia (Parmeliaceae)

Amer. J. Bot. 64 (6) :664-669

Species of Parmelia subg. Xanthoparmelia exhibit partial morphological convergence in a region of sympatry in the northern portion of the Sonoran Desert. Within the isidiate morph of the population, chemotypic variation is present. These chemotypes exhibit habitat selection among different rock substrates within a region of relatively uniform climate and topography. Partial habitat selection is also demonstrable for the chemotypes of the nonisidiate morph in the population. Other morphological characters are useful in segretating portions of the isidiate and nonisidiate morphs into chemically distinct groups that have previously been assumed to represent only chemotypic variation.

Nelson, A.

1898

The Red Desert of Wyoming and its Forage Resources

U. S. Department of Agriculture, Division of Agrostology, Bulletin 13 72 p.

This early description of the Red Desert remains a good reference for the area. This area of 85 by 130 miles embraces more than 11,000 square miles. Vegetation is dominanted by sagebrush and saltbushes of several species.

Nelson, E. W.

1921

Lower California and its Natural Resources

National Academy of Sciences, Memoirs 16 :1.194

This article includes a description, with illustrations, of the vegetation of the area.

Nicholson, R. A., Hulett, G. K.

1969

Remnant Grassland Vegetation in the Central Great Plains of North America

J. Ecology v.57 :599

Numerous ecological studies concerning the vegetation of grasslands in the Great Plains have been conducted, from the prairies of south-central Canada to those of west-central Texas. Studies such as those by Coupland (1950, 1961), Moss (1955) and Hulett, Coupland & Dix (1966) characterized much of the vegetation of the Great Plains region of Canada.

Hanson & Whitman (1938), Tolstead (1941) and Larson & Whitman (1942) investigated the Great Plains vegetation of the northern United States. In the Southern Great Plains, Brumer (1931) described the vegetation of Oklahoma and Dyksterhuis (1946) and Launchbaugh (1955) wrote about Texas prairies.

The area concerned in the present study is the Central Great Plains of North America. Detailed study portraying the ecology of remnant grassland vegetation in the region is unprecedented. The majority of the ecological studies in Kansas (Hopkins 1955) concern grazing, drought or both. Studies by Clements (1920), Albertson (1937), Albertson & Weaver (1942, 1946), Tomanek & Albertson (1953, 1957), and Albertson & Tomanek (1965) were important in characterizing grazing and drought ecology of western Kansas grasslands. Weaver & Albertson (1956) compiled the results of many studies concerning Great Plains grasslands.

The vegetation of Nebraska has been qualitatively characterized in its entirety by Weaver (1965). Pool (1914), Tolstead (1942) and Burzlaff (1962) reported on areas in the Nebraska Sandhills and Weaver & Bruner (1948) and Hopkins (1951) characterized the vegetation of the loess hills in the central portion of the state. Lang (1945) reported upon stands in adjacent eastern Wyoming, while areas in Colorado have been characterized by Vestal (1914) Ramaley (1939), Costello (1944) and Livingston (1952).

The primary objective in the present study is a detailed ecological evaluation of the vegetational characteristics of some grassland remnants and their sites in six of the major

and resource areas (Austin 1965) in the Central Great Plains. Wnen the criteria Austin used to delineate these resource areas were examined, we decided they would be a meaningful foundation upon which a large munber of undisturbed prairie remnants could be characterized and compared.

Niering, W. A.; Whittaker, R. H.; Lowe, C. H.

1963

The saguaro, a Population in Relation to Environment

Science 142(3588) :15-23 BA 45(11)45128

An excellent discussion of the saguaro, its relationship to the plant communities in which it occurs, and factors that determine it establishment and survival. The Saguaro is a major plant of the Sonoran Desert, occurring in a number of types of desert and extending into the desert grassland. It reaches its maximum population density in the Tucson area at lower elevations on the dry slopes of mountains. It is reproducing well on rocky slopes and in some bajada communities but is failing to reproduce on the finer soils of bajada affected by grazing. The authors believe grazing subjects the population to gradual disaster, with failure to reproduce resulting in slow decline to disappearance. Freezing and disease may cause a temporary setback, or kill older plants.

Nord, Eamor C.

1965

Autecology of Bitterbrush in California

Ecological Monographs v.35 (3) :307

Table of Contents

Few native shrubs in California have attracted as much attention as bitterbrush (Purshia spp.). Abundant where it grows, this plant is palatable and nutritious for game and livestock. It is also widespread over other portions of the western United States. Bitterbrush includes both antelope bitterbrush (P. tridentata (Purch.) D.C.) and desert bitterbrush (P. glandulosa Curran). It has been studied extensively, but most such studies have been directed towards applied objectives; only a few are concerned with the ecology of antelope

2 18 - A

bitterbrush stands and then limited to a small geographic area. These investigations have yielded information on artificial reestablishment and grazing management practices, but they have touched only peripherally on the ecology of both antelope and desert bitterbrush.

The present study was undertaken to (a) obtain a more precise phytosociological description of existing bitterbrush stands in California; (b) identify the physical and biological factors associated with their distribution and abundance: (c) determine the effects of various environmental factors on reproduction, development, growth, longevity, and succession; and (d) develop knowledge of the ecological life histories and characteristics of both antelope and desert bitterbrush.

Ochoterena, I

1945

Outline of the Geographic Distribution of Plants in Mexico

In Plants and Plant Science in Latin America, Chronica Botanica Co., Waltham, Mass, BA 20(1)200

Another of the brief but good descriptions found in this book. The desert regions are discussed with the other major vegetation types in Mexico.

Palmer, E. J.

1929

The Ligneous Flora of the Davis Mountains, Texas

Arnold Arboretum, Journal 10(1) :8-45 BA 4(5)16134

The topographical, geological, and climatic features of the Davis Mountains are discussed as a basis for describing the vegetation of various situations and altitudes. The vegetation of the lower and more open portions is described as being more-or-less xerophytic and belonging to the Sonoran province. The second part of the article consists of an annotated systematic enumeration of the woody plants collected.

Parish, S. B.

1930

Vegetation of the Mohave and Colorado Deserts of Southern California

Ecology v.11 (3) :481

The great desert of southern California, which in area exceeds the combined Montane and Cismontane regions, is, in popular usage, divided into two parts: the Colorado Desert and the Mohave Desert. A consideration of their geological history, their physiognomy and their plant populations affords grounds for sustaining this subdivision, always in subordination to the more general conditions which pervade both and show them to be parts of one greater whole. This study includes some of the identities and some of the differences which characterize these two parts, and more particularly, some of the outstanding features of the Mohave Desert.

Pase, C. P.

1972

Litter Production by Oak- Mountain Mahogany Chaparral in Central Arizona

U S D A Forest Service Research Note RM-214 :7

Annual litter fall from shrub live oak was 192 G/M2 crown area on southerly slopes, and 138 G on northerly slopes. For the chaparral community as a whole, southerly aspects produced 193 G/M2 crown areas and northerly aspects, 215 G. Most litter fell during late spring and early summer, least in fall and early winter. Forest floor varied from 9.2 to 27.1 metric tons per HA. Maximum water retained against free drainage was 4.8 MM under shrub live oak and 5.1 MM under pringle manzanita. (Pase-Forest)

Passey, H. B.; Hugie, V. K.

1962

Application of Soil-Climate-Vegetation Relations to Soil Survey Interpretations for Rangelands

J. Range Management v.15 (3) :162

Perspectives, objectives, methods and techniques employed in the appraisal and interpretation of rangeland resources during the present century reflect the gradually evolving demand for more basic knowledge. The needs of an increased population can result only in more intensive use and treatment of agricultural lands, including those devoted to production of forage for livestock and game animals. Intelligent intensification of the use and management of any resource must be based upon extensive knowledge of that resource and its wise interpretation.

Passey, H. B.; Hugie, V. K.

1962

Sagebrush on Relict Ranges in the Snake River Plains and Northern Great Basin

Journal of Range Management 15(5) :273-278 BA 43(1)406

Compares the kind, amount, and character of sagebrush on various types of soil found in the Snake River Plains and northern Great Basin. Big sagebrush (Artemisia tridentata) was the most common and occurred on the greatest number of soils. Includes data useful to any studies in which plant-soil relationships are involved.

Passey, H. B.; Hugie, V. K.

1963

Some Plant-Soil Relationships on an Ungrazed Range Area of Southeastern Idaho

J. Range Management v.16 (3) :113

A problem encountered in range site delineation is that of confusing sites with range condition classes. This problem arises most frequently when too much reliance is placed on the present vegetation and too little on soil and climatic factors in the identification of sites on ranges subjected to heavy grazing or other disturbance.

Soil and climatic factors known to be associated with specific natural plant communities, because of their permanence, thus become more reliable indicators of range sites than does the nature of an altered plant community.

Paulsen, Harold A., Jr.

1953

A Comparison of Surface Soil Properties Under Mesquite and Perennial Grass

Ecology v.34 (4) :127

Since the settlement of the Southwest, velvet mesquite (Prosopis juliflora var. velutina (Wootd.) Sarg.) has invaded large areas of former semidesert grassland range. Formerly confined mainly to the alluvial soils of the primary drainages, this tree-like shrub has become established on many new sites which encompass a considerable range of soils, topography, and climatic conditions. The resulting loss in grazing capacity and difficulty in handling livestock have centered attention on the processes involved in the invation and methods which are economically feasible for control of mesquite.

Studies by Glendening (1952) and Brown (1950) have shown that once invading trees reach seed-producing size, mesquite may be expected to become the dominant species of the vegetative cover. After it has passed the seedling stage, velvet mesquite successfully competes with the herbaceous undercover for the limited moisture which occurs throughout the semi-desert type.

Invasion is accompanied on areas of continual heavy grazing by a reduction in density and vigor of the grasses and accelerated soil movement. The wide-spreading lateral root system and the open crown canopy of mesquite are not effective in stabilizing the soil or contributing to its improvement. As the stand of mesquite continues to thicken, the effects of soil erosion become more prevalent; roots of the perennial grass are often exposed and the soil surface becomes noticeably more irregular.

The results of a comprehensive analysis of soil samples obtained from an area of rangeland which is currently undergoing the transition from perennial grass to mesquite are presented in this paper. They are intended to supplement other ecological findings on the spread of mesquite and to provide an indication of accompanying edaphic changes on one widespread soil type.

Peacock, J. Talmer, McMillan, Calvin

1965

Exotypic Differentiation in Prosopis (Mesquite)

Ecology v.46 (1) :35

Laboratory-germinated seedlings of 26 populations, representing three species of Prosopis and obtained from a wide geographic expanse bounded by the Oklahoma-Kansas border to the north and inclusive of continental Mexico to the south, were utilized in experimental ecology during 1961 and 1962. In germination, no population or species character was affected by temperature or light. The ultimate height of seedlings on an experimental, reconstituted soil was substantially greater than for plants on a natural, acid soil from eastern Texas. Ten-, 12-, 14-, and 16-hr photoperiods with some temperature control and 12-, 14-, and 16-hr photoperiods under two temperature regimes resulted in less maximum height and an earlier inception of dormancy in Oklahoma and Texas populations. More southerly populations were less influenced by photoperiod. All populations had significantly greater heights under warm nights (24°C) than under cool nights (13°C) at a day temperature of 30°C. In an experimental garden, a gradient in mean height and date of dormancy inception was recorded, more northern populations having lower maximum height averages and earlier dormancy. Freezing promoted dormancy in the Mexican populations. Spring activity was primarily under the influence of temperature. An ecoclinal response to low temperature, correlated with latitude of origin, showed least frost resistance in Mexican populations. The northern distribution of Prosopis is probably limited by the severity of winter temperatures; the eastern distribution is probably limited by edaphic factors. Ecotypic differentiation over the northern part of its range adds weight to the historical evidence that mesquite has occupied its current distribution for a considerable period of time. Orderly evolutionary developments have undoubtedly resulted in ecological differentiation in diverse habitats and thus have effected the presented distritution of mesquite.

Pearson, G. A.

1920

Factors Controlling the Distribution of Forest Types, Part I

Ecology v.1 (3) :139

Every student of plant life in our western mountain regions is familiar with the altitudinal zonation which characterizes the distribution of the forest trees. To the forester this phenomenon is of great significance, since it enables him to determine offhand what species to expect at any altitude on a slope of a given aspect. To the student of problems concerning the growth and perpetuation of forests it affords an excellent opportunity for studying the soil and climatic requirements of different species. The presence or absence of certain species at certain altitudes and slope exposures is immediately associated with temperature, moisture, and other factors prevailing on these sites.

Pearson, G. A.

1920

Factors Controlling the Distribution of Forest Types, Part II

Ecology v.1 (4) :289

The first phase of this study dealt with the measurement of soil and climatic factors in each forest type. The second phase seeks to apply the results in explaining the presence or absence on different sites of various tree species indigenous to the region, and then to determine the limiting factors in the distribution of each species and forest type. A more direct way would be to grow the trees under controlled conditions, but in view of the long life period of trees and their demands upon space, the physical difficulties in the way of such an undertaking render it desirable first to collect all the information available from a study of natural conditions.

Pieper, R.D.

1968

Comparison of Vegetation on Grazed and Unglazed Pinyon-Juniper Grassland Sites in Southcentral New Mexico

J. Range Management 21:51

A study to compare vegetation on three grazed areas with that on comparable areas, protected for 12 years, on the Fort Stanton Range revealed that both herbage production and height of blue grama plants were significantly higher on protected areas for all three sites. Species composition was not significantly different between grazed and protected areas on the stony hills site, but composition of mat muhly was significantly higher on grazed areas on both loamy upland sites. Composition of blue grama and western wheatgrass was significantly lower on the grazed area on the loamy bottomland site.

Potter, Loren D.

1957

Phytosociological Study of San Augustin Plains, New Mexico

Ecological Monographs v.27 (2) :113

Table of Contents

The object of this study has been to map the distribution and to determine the composition of the principal vegetational types in the drainage basin of the San Augustin Plains. The results are reported here in a variety of phytosociological attributes along with a discussion of the influence of climate and soils.

Powell, J.

1970

Site Factor Relationships With Volatile Oils in Big Sagebrush

J. Range Management 23:42-46

The volatile oil content in big sagebrush leaves varied greatly on different sites, ranging form 3.5 percent of the air-dry weight in short plants on poor sites to 6.0 percent in tall plants on favorable sites. A regression equation using selected site factors accounted for 91 percent of the variation in oil content. Oil content was most highly correlated with sagebrush size and the amounts of magnesium and phosphorus in the A horizon. Short big sagebrush plants on poor sites should be maintained as forage plants, but tall big sagebrush plants on favorable sites should be replaced with other more palatable species. Chemicals which can reduce or retard volatile oil production should be studied.

Purer, Edith A.

1936

Studies of Certain Coastal Sand Dune Plants of Southern California

Ecological Monographs v.6 (1) :1

Table of Contents

The published literature on the vegetation of the coastal sand dunes of southern California is concerned with taxonomic matters and to a much lesser degree with successional relations. The present investigation deals with the autecology of some representative species of plants of this area. In addition certain environmental conditions have been studied, in order to determine under what general ranges of these important conditions this particular sand dune vegetation exists.

Raheja, P. C.

1966

Aridity and Salinity, A Survey of Soils and Land Use

Salinity and Aridity, New Approaches to Old Problems :43-127

No abstract available

Ramley, Francis

1939

Sand-Hill Vegetation of Northeastern Colorado

Ecological Monographs v.9 (1) :1

The sand areas of Colorado include many districts of a few square miles in the plains region, and also certain smaller stretches in the higher valleys and mountain parks. Those somewhat fully studied by the writer are as follows: Roggen and northwest of Roggen, in Weld County; various eastern parts of the state, especially Washington, Sedgwick, and Yuma counties; White Rocks and Gunbarrel Hill in eastern Boulder County; Utah Junction and Globeville, respectively at the north and northeast city limits of Denver. Additional areas of sand in other parts of Colorado examined are: the eastern part of the San Luis Valley in Saguache County, with the Great Sand Dunes (Ramaley, 1929), Clear Creek Valley near Georgetown, Clear Creek County (Ramaley, 1919); the sand dunes of North Park in Grand County, the sand dunes of the Arkansas Valley in southeastern Colorado, especially in the neighborhood of Lamar.

It is natural to make comparisons with the sand hills of Nebrasks, so well known because of their great extent, occupying about 20,000 square miles in the west-central part of the state. They have been described by Rydberg (1895), Pound and Clements (1900), and Pool (1914), the last-named giving a full discussion of physiography, climatology, and floristics. Since the sand hills of northeastern Colorado lie only 100 to 300 miles west of the sand-hill area in Nebraska, it is to be expected, and it actually is the fact that there is great similarity both ecologically and floristically in the two areas. Similarities and differences are pointed out in later sections of this present paper.

Among the most satisfactory for study are the sand hills to the north and west of Roggen, in Weld County, where they exhibit the features of true dunes (Fig. 1). Others are near Brush, Oits, and Akron. Not any of them are of great height, 50 feet at Roggen, seldom 100 feet anywhere in northeastern Colorado. Crater-like depressions, "blow-Outs," occur on northwest exposures, and there is much loose sand,

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Ramley, Francis, et al, 1939
Page Two

especially in "deposit patches" to the lee of blow-outs. Elsewhere in many parts of eastern Colorado visited by the writer there are fewer recently formed craters, and most of the sand hills are composed, at least superficially, of sandy loam or sandy clay, and support a somewhat stable, although meagre, vegetation.

Rauzi, F.; Smith, F.M.

1973

Infiltration Rates: Three Soils With Three Grazing Levels in Northeastern Colorado

J. of Range Management 26(2):126

The influence of soil type, grazing level, and vegetation on infiltration rates were evaluated at the Central Plains Experimental Range near Nunn, Colorado. Total plant material was significantly correlated with infiltration rates on two of the three soil types tested. Heavy grazing significantly decreased infiltration rates on two of the soil types. Grazing influences did not reduce infiltration rates until after 20 minutes of simulated rainfall.

Reed, E. L.

1930

Vegetation of the Playa Lakes in the Staked Plains of Western Texas

Ecology v.11 (3) :597

The Staked Plains have an altitude of about 3,400 feet above sea-level, and their general slope is southeast and south. The land surface is a plain of deposition, little modified, composed of sediment carried down by streams from the Cordilleran region to the west in Tertiary and Pleistocene times; and is, therefore, comparatively recent. There is practically no stream development or drainage, and the plains are generally flat with scarcely any irregularities except occasional depressions or swales and shallow basins containing intermittent lakes known as playas. These range in depth from a few inches to 60 feet or more, are circular in contour and bowl-shaped with smooth slopes. In area they range from a few square feet to 400 acres or more, and are dry most of the year, but contain water for short periods after a heavy rainfall. Having no outlets, the water is lost by evaporation and by percolation.

Geologists advance four theories for the formation of these playas: (1) that they are solution sinks, (2) that they are remains of old water courses which have been almost filled by wind-blown material, (3) that they are due to differential settling, and (4) that they are formed by wind action. Each of these theories may account for a greater or less number of the playas. Whatever their origin, there is no doubt but that they are at present being filled by the small amount of drainage into them and by wind action.

Rice, B.; Westoby, M.

1978

Vegetative Responses of Some Great Basin Shrub Communities Protected Against Jackrabbits or Domestic Stock

J. Range Management 31(1):28

We surveyed the vegetation at 19 locations inside and outside 12 exclosures built at various times in Curlew Valley, northern Utah. The exclosures were in semi-desert shrub vegetation and included several communities definable by a dominant perennial shrub distribution having sharp boundaries. At the level of the individual quadrat, there was no correlation between the density of any of the abundant annuals and the percentage of the soil surface that was bare, or covered by rock, dead plant matter, or cryptogam crust. The communities as defined by dominants arranged themselves in the order winterfat, shadscale, shadscale and perennial grasses, sagebrush, black sage. These communities are known to be found on progressively less xeric sites. The changes which resulted from protecting samples of these communities from grazers were fairly consistent within each community, but differed among communities; and moreover, these changes were not correlated with a trend from more to less xeric sites. Protection against sheep, with or without protection against jackrabbits, did not have very many effects even over 15 years: halogeton generally decreased; peppergrass increased where present, winterfat increased in vigor but not in density where it was dominant. Other dominant shrubs and perennial grasses did not respond to protection. Protection against jackrabbits had no consistent extra effect on the parameters studied. The classical concept of range succession is that recovery from overgrazing moves a community through secondary succession parallel to a gradient towards relatively more mesic conditions. On the whole, this concept has not been useful in interpreting the results of excluding grazers from these semiarid shrublands.

Richard, W.H.; Murdock, J.R.

1963

Soil Moisture and Temperature Survey of a Desert Vegetation Mosaic

Ecology 44(4):821-824

From March 4 to May 9, 1960, soil temperature and moisture measurements were made in seven plant habitats on the Nevada test site, Nye County, Nevada. Soil moisture was determined by gravimetric sampling, and temperatures were measured using the sucrose inversion technique. Cooler soil temperatures were not always associated with an increase in elevation. In some cases, topographic positions and soil properties influenced soil temperatures and available soil moisture more strongly than did elevational changes.

Richard, W. H.

1967

Seasonal Soil Moisture Patterns in Adjacent Greasewood and Sagebrush Stands

Ecology, v.48 (6) :1034

Soil moisture measurements were made over a 2-year period in adjacent greasewood (Sarcobatus vermiculatus) and sagebrush (Artemisia tridentata) stands in the desert steppe region of southeastern Washington. Soil moisture accumulated during fall and winter. The greater accumulation of moisture in the upper 4 dm of the greasewood stand appeared to be the result of decreased evaporation losses and the lack of transpiration from shrub species which are leafless during winter and early spring. The more luxuriant growth of cheatgrass in the greasewood stand was related to winter and spring retention of soil moisture.

Rickard, W.H.; Keough, R.F.

1968

Soil-Plant Relationships of Two Steppe Desert Shrubs

Plant and Soil XXIX (2):205

Hopsage, Grayia spinosa, and greasewood, Sarcobatus vermiculatus, are common shrubs in the steppe desert regions of the northwestern United States. These plants behave differently in regard to growth phenology and mineral uptake even when growing side-by-side. The leaves of hopsage emerge in late February and early March. The leaves die and begin to fall from the branches in mid-summer. In this manner, hopsage is able to exploit soil moisture derived from winter precipitation that normally is stored in the first meter of soil depth in winter and early spring. The plant remains dormant during the hot, dry summer months. Greasewood, therefore, is a phreatophyte obtaining moisture from a permanent water supply located well below the depth of seasonal precipitational percolation. This paper describes the plant and soil mineral relationships of greasewood and hopsage shrubs growing in close proximity on the Hanford Reservation, Benton County, Washington.

Rixon, A.J.

1971

Oxygen Uptake and Nitrification by Soil Within a Grazed Atriplex vesicaria Community in Semi-Arid Rangeland

J. Range Management 24:435

The effect of plant distribution on oxygen uptake and nitrification in surface soil of a semi-arid rangeland community was studied. Oxygen uptake and nitrification in surface (0-7.5 cm) soils from sites associated with Atriplex vesicaria bushes were at least twice as great as in soils from the interbush area. The pattern of nutrient cycling tended to reflect the distribution of plant material within the plant community. The effect did not extend to the 7.5 to 15 cm soil horizon. The rate of nitrification per unit total soil nitrogen was greater for the sites associated with the saltbush than for the interbush area. These differences in rate of nitrification per unit total nitrogen persisted for at least two years following the total elimination of saltbush (Atriplex vesicaria) by heavy grazing.

Robertson, D.R.; Nielsen, J.L.; Bare, N.H.

1966

Vegetation and Soils of Alkali Sagebrush and Adjacent Big Sagebrush Ranges in North Park, Colorado

J. Range Management 19:17

Alkali sagebrush ranges were found to have a shallow, root restricting claypan soil. In contrast, the adjacent big sagebrush plant community occurred on loamy soils where roots penetrated freely. This direct relationship between range sites and soils shows how soil surveys can be used to determine range sites.

Robertson, Philip A., Ward, Richard T.

1970

Ecotypic Differnetiation in Koeleria Cristata (l.) Pers. From Colorado and Related Areas

Ecology v.51 (6) :1083

The phenological and morphological response of populations of Koeleria cristata (l.) Pers. from Colorado and related areas in a transplant garden at Ft. Collins indicated marked heritable differences. Most significantly, and contrary to what would be predicted on the basis of other such studies involving elevational gradients, the highest collections from Colorado (about 2,850 m) were latest in development. The moisture regime of the native habitats was a more important selection force than the length of the growing season. Plants from the northern plains were similar in phenology and morphology to plants from the plains-foothills region of eastern Colorado. Two, and possibly three, regional relationships are suggested for the Colorado populations.

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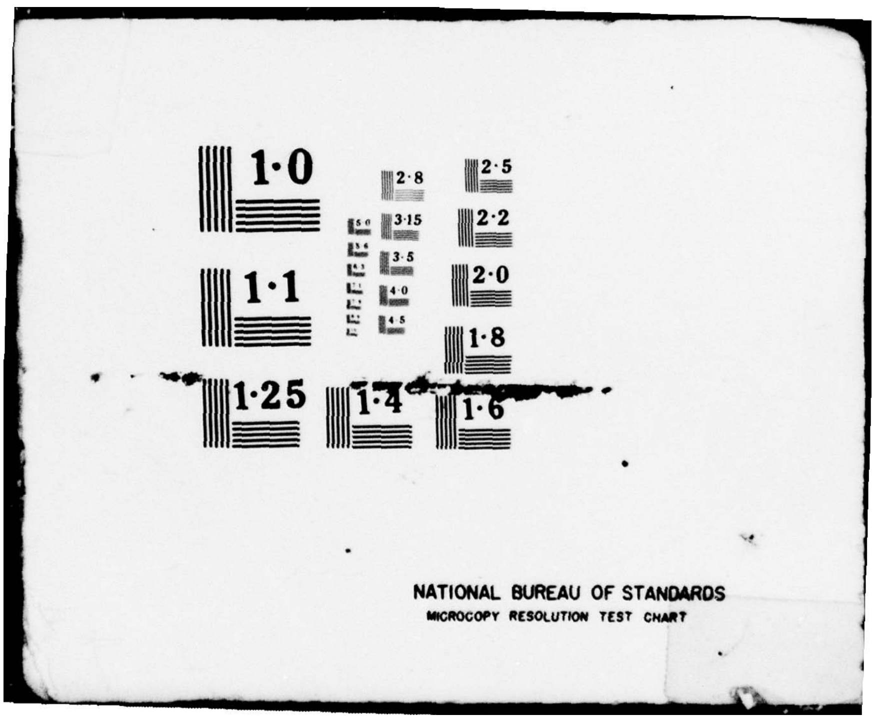
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Rowell, C.M.Jr.

1971

Vascular Plants of the Playa Lakes of the Texas Panhandle and South Plains

Southwestern Naturalist 15(4):407-417

Playa Lakes, usually shallow, rain-fill depressions occurring in the high plains of Texas have a characteristic vascular plant flora. Sixty-five species in 26 families are discussed in reference to distribution in the region, habitat preference and period of anthesis.

Salisbury, Frank B.

1964

Soil Formation and Vegetation on Hydrothermally Altered Rock Material in Utah

Ecology v.45 (1) :1

In the south-central part of Utah near Marysvale, exposed cross sections of ancient hot springs support vegetation strikingly different from the surrounding semi-desert plant communities. A similar situation in Nevada has been studied by Billings (1950), and chemical and biological investigations of the hot-spring material in Utah have been described earlier (Salisbury 1954). The present paper bears on the ecology of the hot-spring areas, especially in relation to soil formation on the material derived from hydrothermally altered rock.

Sampson, A. W.

1939

Plant Indicators: Concept and Status

Botanical Review 5(3) :155-206

An excellent discussion of plants in relation to climate, soils, grazing use, fire, and other factors. Also an excellent review of literature and an extensive bibliography.

Saunders, D.V.; Young, J.A.; Evans, R.A.

1973

Origin or Soil Mounds Associated with Clumps of Ribes velutinum

J. Range Management 26(1):30

The mounds of soil associated with multi-stem clumps of Ribes velutinum Greene are apparently the result of rodent activity and are not remnant erosion surfaces. The development of the mounds is a dynamic response to stand renewal by burning. Rodents apparently are attracted by the increase in annuals, especially downy brome, which occurs after fire. The protection of the spiney clumps of resprouting Ribes provides a safe place for the rodents to build their dens.

Saunier, R. E., Wagle, R. F.

1966

Factors Affecting the Distribution of Shrub Live Oak (Quercus Turbinella Greene)

Ecology v.48 (1) :35

The disjunct distribution, reproduction, and rooting habits of Quercus turbinella in the Arizona chaparral were studied on quartz diorite, sedimentary, and volcanic substrata. The oak was less dense on the sediments and volcanics than on quartz diorite. Lower densities on the bedded sediments resulted from restricted root penetration which prevented access to deep soil moisture: on the volcanic substratum heavy clay soils gave an overall poorer moisture regime than soils developed from the quartz diorite. Shrubs growing on the less favorable sedimentary and volcanic substrata probably were more susceptible to damage by drought and fire, and low mobility and low seedling production tended to eliminate the species from these areas. It is suggested that the Q. turbinella "islands" within large areas of grassland are relicts rather than evidence of invasion.

Schulz, E. D.

1930

Texas Cacti, a Popular and Scientific Account of the Cacti Native of Texas

Texas Academy of Science, Transactions 14 :1-181 BA 5(8-9)21314

A popular account of the cacti of Texas including their distribution, ecology, disease and insect enemies, and a description of every species known to be native to Texas. A key to the species of Opuntia is included.

Shantz, H. L.

1925

Plant Communities in Utah and Nevada

U. S. National Herbarium, Contributions 25 :15-23

Shantz prepared the portion on plant communities of this publication on the flora of Utah and Nevada. The desert communities are listed: northern desert shrub, salt desert shrub, and southern desert shrub. These are further subdivided and described.

Shantz, H.L.

1938

Plants as Soil Indicators, In Soils and Men

US Dept. of Agriculture, Yearbook p. 835-860

The use of plants as indicators of temperature, rainfall, drought, and soil moisture conditions is described. Shortgrass is subdivided into 10 vegetation types and the soil preference of each is given.

Shantz, H. L.; Piemeisel, R. L.

1924

Indicator Significance of the Natural Vegetation of the Southwestern Desert Region

Journal of Agricultural Research 28(8) :721-801

This publication, which has been a very valuable asset in the development of irrigation in the Southwest, lists the principal plant indicators of soil conditions. For example, it is stated that a good stand of creosotebush indicates land which has good drainage and is free from alkali. Mesquite and chamise, or chamise alone, indicate a very sandy soil free from alkali. Yucca and cactus lands, and giant cactus and paloverde lands, are too stony or the slope too steep for cultivation. The indicators of saline conditions and poor drainage are also given.

Shantz, H. L.; Piemeisel, R. L.

1940

Types of Vegetation in Escalante Valley, Utah, as Indicators of Soil Conditions

U. S. Department of Agriculture, Technical Bulletin 713 46 p.

The authors found that the most reliable indicators of soil conditions are the stabilized plant associations in equilibriem with soil and climatic conditions. They noted that little rabbitbush indicates lighter soild, and that progressively heavier soils are indicated by galleta grass, sagebrush, greasewood, shadscale, winterfat, greasewood-shadscale, and saltgrass. Thus it is possible to determine the soil texture, from light sands to heavy clays, by noting the vegetation.

Shantz, H. L.; Zon R.

1924

Natural Vegetation

U. S. Department of Agriculture, Atlas of American Agriculture, Pt. I. Sec. E. 29 p.

An excellent colored map of the natural vegetation of the United States with very good descriptions of plant communities. The authors recognize northern desert shrub with three main associations and a number of minor communities, including sagebrush, shadscale, and saltsage. Their southern desert shrub category includes desert saltbush, creosotebush, yucca, cactus, and California sagebrush mesquite.

Sharma, M.L.

1973

Soil Physical and Physico-Chemical Variability Induced by Atriplex nummularia

J. Range Management 26(6):426

Spatial variability in two soils supporting 10-year-old stands of saltbush (Atriplex nummularia) was examined by evaluating various soil physical and physico-chemical properties under and between the plants. The differences in soil properties between these two positions were mostly significant for the surface layer (0 to 7.5 cm) but only in a few cases for the 7.5 to 15 cm layer. No differences were observed below this depth. Presence of A. nummularia resulted in increased electrolyte concentration, higher sodium adsorption ratio, and higher levels of exchangeable sodium and organic matter in the surface soil. Standard laboratory measurements showed that these physico-chemical changes induced a significant deterioration in the structure of the surface soil under the plants as indicated by reduced aggregate stability, poorer drainage, and lowered hydraulic conductivity. Field studies suggested that the bulk density of the surface soil was reduced under the plants but that water penetration and storage in the profile after rains remained unaffected. Probably reasons for these effects are discussed.

Sharma, M.L.; Tongway, D.J.

1973

Plant Induced Soil Salinity Patterns in Two Saltbush (Atriplex spp.) Communities

J. Range Management 26(2):121

A detailed examination was made into the soil salinity distribution of two Atriplex communities, A. vesicaria and A. nummularia, established at regular spacings on two soil types. The results based on total soluble salts and chlorides suggested that both the saltbush species induced significantly higher salinity in the 0 to 15 cm soil horizon beneath the bush canopies compared to between the bushes, although A. nummularia induced significantly higher salinity than A. vesicaria on both the soils. The pH was also significantly increased under the bushes, but only for the 0 to 7.5 cm layer. A mechanism for plant-induced soil salinity is proposed by which distinct zones of salt depletion, accumulation, and compensation are established. It is suggested that the accumulation of significantly large quantities of salt in the surface layer under the bushes occurred as a result of decomposition of large quantities of salt-rich leaves and fruits. This salt is mainly derived from the soil profile under the plant. Implications of the spatial variability in soil salinity are discussed.

Shelford, V. E.

1963

The Ecology of North America

University of Illinois Press, Urbana, Illinois 610 p.

The most comprehensive publication on the ecology of North America, which should be standard reference for everyone scientifically interested in the flora and fauna of North America.

Shields, Lora Mangum

1956

Zonation of Vegetation within the Tularosa Basin, New Mexico

The Southwest Naturalist v.1 (2) :49-68

The vegetation on two unusual substrates (lava and gypsum sand) is compared, and causative factors influencing distribution are discussed.

The Tularosa Basin in south central New Mexico provides a situation which illustrates the interaction of several rigorous environmental factors in determining plant distribution. The north central part of the basin is an arid valley upon which two strikingly contrasting smaller environments are superimposed. One, a deposit of drifting gypsum, the Alamogordo White Sands, lies in the lowest part of the basin at the site of a Quaternary lake. The other, a lava bed, the Carrizozo "malpais" or "badlands," believed to have been extruded within the past one thousand years, parallels the main axis of the basin, approximately the northern two-thirds lying within the Upper Sonoran and the lower third with the Lower Sonoran Zone. The lava flow extends at the southern tip to within 15 miles of the gypsum sand.

The present paper analyzes the several causal factors determining plant distribution in the gypsum deposit, the neighboring lava flow to the north, and the alkaline plain surrounding these two areas.

Shields, Lora Mangum, Crispin, Joe

1956

Vascular Vegetation of a Recent Volcanic Area in New Mexico

Ecology v.37 (2) :341

The two adjacent lava beds at Carrizozo, New Mexico, known locally as the malpais, the Spanish term for badlands, lie in the northern part of the Tularosa Basin, an internal drainage area of approximately 6,000 square miles. The smaller, earlier flow, roughly triangular in outline and covering about 25 square miles to the northwest of the recent lava bed, was erupted during the Pleistocent (Meinzer and Hare 1915). The more recent volcanic deposit is estimated to have been extruded within the past 1,000 years (Allen 1951) from a small cone at the northern end and possibly from other cones now buried.

The present paper (a) considers the distribution of vascular vegetation in relation to the several types of habitats within the younger lava flow, as well as to altitude, and (b) compares the vegetation of this recent volcanic deposit to that of other parts of the surrounding Tularosa Basin with respect to diversity of species. This work was done as a preliminary to making analyses for micro-Kjeldahl amino leaf nitrogen of the more prominent species and determinations of soil nitrite and nitrate.

Shields, Lora Mangum

1957

Algal and Lichen Floras in Relation to Nitrogen Content of Certain Volcanic and Arid Range Soils

Ecology v.38 (4) :661

This report evaluates algo- and lichen-stabilized surface crusts as nitrogen sources in soils from 13 volcanic areas in 5 western states and from typical range land of northeastern New Mexico. The study is an extension of an investigation of alga- and lichen-stabilized surface crusts as continually renewable sources of soil nitrogen in the Carrizozo, New Mexico, lava flow and the surrounding arid plain. It is based upon soil samples from a number of western volcanic areas and upon local range soils in northeastern New Mexico, which were being analyzed simultaneously.

Shown, L.M.; Miller, R.F.; Branson, F.A.

1969

Sagebrush Conversion to Grassland as Affected by Precipitation Soil and Cultural Practices

J. Range Management 22

The most successful conversions of sagebrush to crested wheatgrass, in areas of the Western United States that receive an average of 8 to 14 inches of precipitation annually, usually occur where the annual precipitation exceeds 10 inches and on soils having medium moisture-holding capacities. Conversion results were intermediate on coarse soils having low moisture-holding capacities and comparatively poor on fine soils having high moisture-holding capacities. Degree of grass establishment varied directly with the big sagebrush vigor-index. Grass production was lower on gravelly sites converted from black sagebrush. Cheatgrass hindered the establishment of crested wheatgrass in some places. Conversion results were poor on sites where greasewood or shadscale was mixed with sagebrush. These halophytes had usually re-established on the treated sites.

Shreve, F.

1915

The Vegetation of a Desert Mountain Range as Conditioned by Climatic Factors

Carnegie Institution of Washington, Publication 217 112 p.

This excellent publication is valuable chiefly because of its interpretation of the influence of the interaction of various factors on plant distribution. The author states that the relative richness of the vegetation in this region is due chiefly to the occurrence of 2 yearly seasons of rainfall. He notes that the severe conditions of the desert environment cause the vegetation to exhibit a high degree of sensitiveness to slight topographic and edaphic differences. Heavier stands of vegetation or else particular species of plants can be found wherever the character of the soil or the topographic location is such as to present a degree of soil moisture slightly above that of the general surroundings, or to maintain the moisture for a longer time during periods of extreme aridity, or wherever plants are protected from the most extreme conditions of transpiration.

Shreve, F.

1922

Conditions Indirectly Affecting Vertical Distribution on Desert Mountains

Ecology 3(4) :269-274

A very good discussion of the factors affecting the vertical distribution of plants, with special emphasis on rocks and their derived soils. The author notes that desert forms obtain a lower maximum elevation on gneiss and granite and that vegetational zones are higher on basalt, rhyolite, and other volcanics.

Shreve, F.

1925

Ecological aspects of the Desert of California

Ecology 6(2) :93-103

In this publication, Shreve proposed a basic thesis: "In a consideration of the dynamic aspects of the vegetation of a region in which the initial, sequential, and final stages of a succession are characterized by the same species, and often by the same individuals, it is doubtful whether these conceptions, formed in regions with a very dissimilar vegetation, are of much real utility." He notes the extreme climatic conditions where some localities have been subjected to several periods of 12 months or more without precipitation. He also states here that there are very few cacti in the Mojave Desert.

Shreve, F.

1926

The Desert of Northern Baja California

Torrey Botanical Club, Bulletin 53(3) :129-136 BA 2(6-8)9194

Includes a description of that region of lower California north of San Felipe Bay and east of the San Pedro Martir Mountains, one of the most arid in North America. The vegetation consists of a very few species; extensive flats subject to inundation by the Colorado River are devoid of plants.

Shreve, F.; Mallery, T. D.

1933

The Relation of Caliche to Desert Plants

Soil Science 35(2) :99-113

An interesting discussion of caliche and its effects upon soil-water and plants, including root penetration. Concludes that the abundance of caliche in the soil of bajadas is important in determining the low and open character of the vegetation, ovten restricted to Larrea Tridentata. In pot tests Larrea grew best with caliche mixed with the soil.

Shreve, F.

1934

Rainfall, Runoff and Soil Moisture Under Desert Conditions

Association of American Geographers, Annals 24(3) :131-156

An analysis of a 27-year period showed that drought periods occurred from 2 to 7 times annually, with the longest drought period lasting 149 days. It was noted that in warm months a period of 2 to 3 weeks without rain will kill herbaceous ephemeral plants, but a period of 2 to 3 months without precipitation will be of little consequence to cacti and deep-rooted trees.

Shreve, F.

1934

Vegetation of the Northwestern Coast of Mexico

Torrey Botanical Club, Bulletin 61(7) :373-380 BA 9(6)10918

An excellent description of the area (which the author characterized as the most arid region in North America), which lies along the lower course of the Colorado River and on both sides of the Gulf of California. In some localities, two species make up 98 per cent of the vegetation, but cover only 4 to 15 per cent of the ground surface.

Shreve, F.

1938

The Sandy Areas of the North American Desert

Association of Pacific Coast Geographers, Yearbook 4:11-14

It is pointed out that sandy areas are not common in the North American desert; much less of the area is covered by sand than in the Sahara, and Asiatic deserts. The sandy areas in the southwestern United States and northwestern Mexico are shown on a map, and the types of plants found there are listed.

Shreve, F.

1939

Observations on the Vegetation of Chihuahua

Madrono 5(1) :1-13 BA 13(10)16266

One of the best publications on the vegetation of Chihuahua. It includes a map and 4 good photographs. Five physiographic regions are recognized in the state: bajada, enclosed basin, elevated plains, Sierra Madre and barranca. The bajada region is desert, dominated by bushes and small cacti. The enclosed basins are desert, with more or less stabilized sand and open vegetation of low trees, bushes and yuccas, or else are open desert grassland. The flora is listed in detail; relative abundance of species is noted. It is also noted that the types of vegetation resemble those of southeast Arizona and southwest New Mexico, with an infusion of endemic or southern species.

Shreve, F.

1940

The edge of the Desert

Association of Pacific Coast Geographers, Yearbook 6 :6-11

A good discussion of the basic philosophy on limits of deserts. It includes a complete summary of the distribution of Larrea together with some factors related to its distrubution.

Shreve, F.

1942

The Desert Vegetation of North America

Botanical Review 8(4) :195-246

A basic study and discussion of the desert vegetation of North America; contains the best overall description, particularly of the warmer desert areas. Desert vegetation, life forms, structure, floristic composition, and geographic areas are discussed for each, of the four great desert regions of North America: the Great Basin, the Mojave, Sonoran, and the Chihuahuan.

Shreve, F.

1942

Grassland and Related Vegetation in Northern Mexico

Madrono 6(6) :190-198 BA 17(6)15363

An excellent discussion of the grasslands of northern Mexico. Although primarily centered on the grasslands, this book is of interest because these grasslands border the desert. As a point of special interest for desert study, the author notes, in the center of the northern plateau, at elevations of 1100-1300 meters the presence of the "Hilaria llanos," undrained basins with deep, fine, soil, with a cover of nearly pure Hilaria. He believes these should be regarded as a desert association controlled by soil conditions, rather than as a part of the climatic grassland formation.

Shreve, F.

1942

The Vegetation of Arizona

In Flowering Plants and Ferns of Arizona. U. S. Department of Agriculture, Miscellaneous Publication 423 :10-23

A very good description. Includes an exceptionally good discussion of desert vegetation, and comparisons with California and Mexican floras. Divides the desert into three types: California microphyll desert, Arizona succulent desert, and Great Basin microphyll desert; describes each briefly and mentions important species.

Shreve, F.

1951

Vegetation of the Sonoran Desert

In F. Shreve and I. L. Wiggins, Vegetation and Flora of the Sonoran Desert, v.1. Carnegie Institution of Washington, Publication 591, v.2

The best available publication on the subject; republished in 1964 as part of a 2-volume publication by Shreve and Wiggins.

Shreve, F.; Wiggins, I. L.

1964

Vegetation and Flora of the Sonoran Desert

Stanford University Press, Stanford, California, 2 vols.
BA 46(5)21937

An outstanding 2-volume report. In the first 186 pages Forrest Shreve discussed the vegetation of the area, a critical analysis and description covering physical factors, perennial vegetation, ephemeral herbaceous vegetation, and ecological features of characteristic species. Includes 27 maps: a large map of the Sonoran Desert and its vegetational subdivisions, another showing rainfall distribution by 5-inch intervals, and 24 maps showing the distribution of important species. This vegetation portion is well illustrated, with 37 of the original plates supplemented by additional photographs. The remainder of the 1740 pages is largely a floristic treatment of the vegetation of the area, and includes: keys to families, genera, and species; detailed technical descriptions; local geographic distribution; and critical notes on habitat, time of flowering, and other factors for each species.

Sims, H. P., Mueller-Dombois, D.

1968

Effect of Grass Competition and Depty to Water Table on Height Growth of Coniferous Tree Seedlings

Ecology v.49 (4) :597

Pinus banksiana, P. resinosa, Picea glauca, and P. mariana seedlings were grown in combination with three grasses on a loamy sand and on a sand, each forming a small catena with a controlled water table. A much greater total vegetative production was achieved on the loamy sand than on the sand with equal water supply. The greater production on the loamy sand, however, did not result in greater tree-seedling heights. On the contrary, at optimum depth to water table (where maximum heights had occurred when grown without grasses in an earlier experiment) for seedlings on the loamy sand the grasses grew more vigorously and suppressed the tree seedlings. On the sand, seedling height trends were not significantly altered from those observed without competition in a previous experiment. Characteristics of competition are elucidated in relation to root- and shoot-growth patterns of seedlings.

Singh, T.

1969

Infiltration and Soil Stability of a Summer Range

J. Range Management 22

Infiltration and sediment production rates, under simulated rainfall, were determined for plots covered with mulear wyethia and on plots from which wyethia had been replaced by grasses as a result of spraying. The sediment produced during the 50-minute period averaged 0.447 ton/acre. As the infiltration rates for the wyethia and grass plots (2.74 and 2.38 in/hr, respectively) were not significantly different, single equations expressing average infiltration rates and mass infiltration were derived for extrapolating experimental results to other areas with similar vegetation.

Slatyer, R. O.

1957

The Significance of the Permanent Wilting Percentage in Studies of Plant and Soil Water Relations

The Botanical Review v.23 (10) :586,587

In 1859 Sachs concluded that the amount of water which remains in soil at the time of permanent wilting of plants varies considerably with the type of soil, increasing from sands to clays. Subsequent investigators (Heinrich, 1894; Gain, 1895; Hedgecock, 1902) confirmed his observation and also found that the percentage of water in any one soil when wilting first occurs varies considerably for different species, increasing from hydrophytes to xerophytes, and is influenced by the climatic conditions obtaining at the time of the determination. Cameron and Gallagher (1908) criticised these conclusions, particularly those of Heinrich, on the basis that the permanence of wilting in their experiments was not properly established at the time soil sampling occurred. It was not until the extensive and thorough investigations of Briggs and Shantz (1911a, 1911b, 1912a, 1912b, 1912c), however, that it was demonstrated that the soil water content at the time of permanent wilting shows little variation from plant to plant on any one soil, regardless of the type or age of the plant, or the climatic conditions under which a determination is conducted.

Briggs and Shantz considered this soil value to be highly significant in terms of plant response, as it appeared not only applicable to all plants but also closely associated with the point at which vegetative growth ceases. Their conclusions were supported by the investigations of Capalunagan and Murphy (1930) and by the extensive studies of Veihmeyer and Hendrickson (1927, 1928, 1934, 1949) and Hendrikson and Veihmeyer (1929, 1945); and the permanent wilting percentage, as it was termed by Hendrickson and Veihmeyer (1929) came into widespread use as a soil characteristic, indicating the lower limit of water availability for all plants.

Studies which have determined the physical condition of soil water at the stage of permanent wilting have shown that for most plants the permanent wilting percentage corresponds to a total soil moisture stress value of 10-20 atm. with a mean value of approximately 15 atm. (Thomas, 1921; Edlefsen, 1934; Schofield and da Costa, 1935; Bouyoucos, 1936; Bodman and Day, 1943; Anderson and Edelfsen, 1942; Richards and Weaver, 1943, 1944; Robertson and Kohnke, 1946). This association of

physical soil data with permanent wilting has provided further support for the concept of the permanent wilting percentage as a soil constant and has led to still wider application of permanent wilting percentage data.

Although the evidence supporting the concept of the permanent wilting percentage as a soil characteristic appears to be well founded, from time to time the validity of this viewpoint has been questioned from both general and specific points of view. Powers (1922) held that laboratory determinations fail to take account of the variation between plants in the field, and so have limited applicability to natural conditions. Crump (1913) considered that age of plant is important and that the use of seedling plants reduces the significance of results. Other workers have shown that the environmental conditions under which determinations are made are of importance (Brown, 1912; Caldwell, 1913; Shive and Livingston, 1914) and that the permanent wilting percentage can vary with different types of plants (Koketsu, 1928; Swezey, 1942; Fowells and Kirk, 1945; Lane and McComb, 1948; Slatyer, 1957a).

The present review seeks to examine the theoretical basis of the permanent wilting percentage, the factors which influence it, the probable extent of their influence, and the significance of the permanent wilting percentage in studies of plant and soil water relations.

Sloan, C.E.

1970

Biotic and Hydrologic Variables in Prairie Potholes in North Dakota

J. Range Management 23:260

Prairie potholes or sloughs are depressions of glacial origin that occur north of the Missouri River in the prairie region of the United States and Canada. Potholes provide valuable wetland habitat for migratory waterfowl and are widely used for stock-water supplies. Differences in climate, geology, topography, ground-water hydrology, and land use create wide variations in pothole hydrology. Plants in and adjacent to potholes are useful indicators of water permanence, depth, and salinity - variables that are important in wetland management.

Smeins, F.E.; Taylor, T.W.; Merrill, L.B.

1976

Vegetation of a 25-Year Exclosure on the Edwards Plateau, Texas

J. Range Management 29(1):24

An evaluation was made of current species composition, production, and 25-year vegetation trends within an exclosure on the Texas A and M University Agricultural Research Station at Sonora, Texas. Community composition was variable and most species responded individually to soil variables, particularly soil depth and degree and kind of stoniness. Common curly-mesquite (Hilaria belangeri) was the most characteristic and widespread species of the area. Communities dominated by Texas cupgrass (Eriochloa sericea), on soils greater than 25 cm in depth, produced 4330, 2235, and 504 kg/ha in June and August 1972 and January 1973, respectively. Wright threeawn (Aristida wrightii) dominated communities with soil depths of 15 cm, produced 1318, 1349, and 413 kg/ha for the same dates; and hairy tridens (Erioneuron pilosum) sites with soil depths of 10 cm yielded 970, 1456, and 84 kg/ha. Vegetation change over the past 25 years has been primarily adjustment in relative dominance of species rather than addition or loss of species. Following establishment of the exclosure some species adjusted to previous grazing history, and thereafter primary changes followed precipitation variation.

Spalding, V. M.

1909

Distribution and Movements of Desert Plants

Carnegie Institution of Washington, Publication 113. 144 p.

This study shows that soil water is the most important factor determining local distribution, and that aeration and alkaline conditions are also important. Spalding notes that creosotebush shows a high capacity for adjustment and "perfect indifference" to change of aspect in the visivity of Tucson, Arizona, that extreme summer heat on south-facing slopes limits the development of some other plants, and that cold temperatures on north-facing slopes limits others, the saguaro for example.

Springfield, H.W.

1971

Winterfat Seedlings Emerge Best From Shallow Seeding, Moderately Dry Soil

J. Range Management 24(5):395-397

Shallow planting of winterfat seeds is important, regardless of soil moisture content or kind of soil. Fewer seedlings emerged in wet soil than in moderately dry soil, even when seeds were planted shallow. Soil texture, and possibly other soil characteristics, may affect emergence. Moreover, although the explanations are not clearcut, there were indications that winterfat is somewhat sensitive to deficient aeration, and dense soil, especially when it is wet, impedes emergence of winterfat seedlings.

Stark, N.; Love, L.D.

1969

Water Relations of Three Warm Desert Species

Israel J. of Botany 18(4):175-190

An area in Death Valley with dry air, persistent winds, low water table, and two to eight cm of rain annually, was studied in an effort to determine the sources of water available to plants and the abilities of three species. Atriplex hymenelytra (desert-holly), Larrea divaricata (creosote bush) and peucephyllum schottii (Pigmycedar) to utilize them. Precipitation, aerial moisture, soil water, and distillation were considered potentially available water sources, and evaporation transpiration, and deep seepage, sources of water loss. Climatic, soil moisture, plant moisture content and transpiration data were obtained and correlated. During periods of higher rainfall deep soil moisture increased and was subsequently depleted at temperatures of less than 36 to 40 C by delivery to the surface soil through distillation and condensation on the undersides of larger rocks near the surface of the coarse soil. Above the hygroscopic level absolute soil moisture was not as important as water delivered by distillation, which was determined to compensate for loss through transpiration. Surface evaporation losses were insignificant, except shortly after rains, while transpiration rates varied with seasonal fluctuations in the plant water status. Larrea showed the greatest physiological adjustment capabilities to low water content and frost, Peucephyllum, the least. Whether the plants utilized aerial moisture was not definitely determined.

Steenbergh, Warren F., Lowe, Charles H.

1969

Critical Factors During the First Years of Life of the Saguaro (Cereus Giganteus) at Saguaro National Monument, Arizona

Ecology v.50 (5) :825

Germination and establishment of the saguaro giant cactus were studied by periodic observations on natural seedling populations, seedling distribution within rocky, rolling hill, and flat terrain habitats, and field-germination experiments in the Sonoran Desert. As a result of bird, mammal, and insect activity, a very small percentage of seeds ($< 1 \times 10^{-3}$ of the seed crop) remains on the ground until suitable conditions for germination occur during the summer monsoon. Germination begins after the start of summer rains in July and continues in August and September. The principal apical stem growth of seedlings takes place during these months, with a few plants exhibiting slight growth during favorable late winter and early spring months. Establishment of seedlings is limited primarily by frost, drought, rodents, and insects, which affect the differential survival associated with seedling size, microhabitat, and season. Initial high rates of seedling mortality drop sharply after the first year and are lowest for plants associated with microenvironments among rock outcrops. The large number of seeds germinated in the alluvial soils of the flat terrain habitats is offset by a higher seedling mortality there. In the rocky habitats more seedlings survive from fewer germinations. The significant difference is attributed primarily to the effect of the microhabitat upon the operation of the critical controlling factors listed above.

Stoddart, L. A.

1941

The Palouse Grassland Association in Northern Utah

Ecology v.22 (2) :158

There are recognized in America several distinct grassland vegetation areas. The major units are the true prairie of the Middle West, the short grass plains immediately east of the Rocky Mountains, the desert plains of the Southwest, the Pacific prairie of California, the alpine grasslands or tundra in the high Rocky, Cascade, and Sierra mountains, and the Palouse grasslands in the northern intermountain region. The Palouse prairie and the Pacific prairie are rather effectively isolated from all other American grasslands by the southern deserts and the Rocky Mountains. Only through Montana and parts of Wyoming do the western bunch grass associations come in contact with the plains grassland associations.

Since the climate and vegetation of the bunchgrass lands and prairie grasslands are so similar, one would expect similar soil developments. True chernozems and chestnut soils are found in each area, and but little difference exists between these soils.

Tidestrom, I.

1925

Flora of Utah and Nevada

U. S. National Herbarium, Contributions 25. 665 p.

The standard flora of these two states. Includes a description of the vegetation by H. L. Shantz.

Tiedemann, A.R.

1972

Soil Properties and Nutrient Availability in Tarweed Communities of Central Washington

J. Range Management 25:438

Comparison of soil nutrient levels and certain soil physical properties between tarweed communities and adjacent stable, productive needlegrass communities indicated a lower nutrient capital of N, S, and exchangeable Mn and poorer physical condition in the tarweed communities. Pot studies with mountain brome and orchard grass revealed low availability of N, S, and P in soils from tarweed communities and suggest a need to amend native soil nutrients with these elements.

Tiedemann, A.R.; Klemmedson, J.O.

1973

Effect of Mesquite on Physical and Chemical Properties of the Soil

J. Range Management 26(1):27

Soil under the crown of mesquite trees was compared to soil from adjacent openings at three depths for several physical and chemical properties near Tucson, Arizona. Bulk density was lower in soil under mesquite but increased with depth in that location. Organic matter, total nitrogen, total sulfur, and total soluble salts were up to three times greater in the surface 0 to 4.5 cm of mesquite soil than in open soil but declined with increasing depth to levels approximately the same depth. Total phosphorus and hydrogen ion concentrations were the same in soil under mesquite as in soil from open areas. Results suggest that mesquite trees function to improve soil conditions under their canopies by redistribution of nutrient ions from areas beyond the canopy to areas beneath the canopy. This process helps to explain the greater abundance and improved growth of perennial grasses observed under mesquite. It also helps to explain grazing patterns and responses on desert grassland.

Tiedemann, A. R., Klemmedson, J. O.

1973

Nutrient Availability in Desert Grassland Soils Under Mesquite (<u>Prosopis Juliflora</u>) Trees and Adjacent Open Areas

Soil Science Society of America, Proceedings, v.37 (1) :107-111

A pot-culture technique was used to evaluate the supply of available soil nutrients, using as indicator plants, three native perennial grasses which are most abundant under mesquite (Prosopis juliflora (Swartz.) DC) trees: Arizona cottontop (Trichachne californica (Benth.) Chase), plains bristlegrass (Seteria Macrostachya H.B.K.), and bush muhly (Muhlenbergia porteri (Scribn.)). The availability of soil nutrients and the measurement of relative yields of grasses were compared with the availability of nitrogen, phosphorus, potassium, and sulfur, in soil under Mesquite trees and adjacent open areas on a desert grassland site. Results minimize the effect of moisture competition between mesquite trees and perennial grasses in explaining meager growth of forage in open areas between Mesquite. A low supply of soil nutrients in soil beyond the Mesquite trees limits forage production, and indicates that even with check treatment and adequate moisture, the stunted chlorotic appearance of Arizona cottontop and plains bristlegrass, plants would not change. Germination of these seeds in open areas between Mesquite trees would be difficult, and moisture stress conditions in desert grassland would probably further restrict establishment. Germination of seed in Mesquite soil would mean a much better chance of becoming established because of a more favorable nutrient regime. (Bahre-Arizona)

Tisdale, E.W.; Hironaka, M.; Fosbert, M.A.

1965

An Area of Pristine Vegetation in Craters of the Moon National Monument, Idaho

Ecology, V.46, No.3, p. 349

A 180-acre kipuka near Carey, Idaho, surrounded by rough lava areas has apparently never been grazed. The entire kipuka is covered by the sagebrush-grass types of which three communities have been recognized and described: the Artemisia tripartita/Festuca idahoensis, the A. tridentata/Festuca idahoensis/Agropyron spicatum, and the A. longiloba/Festuca idahoensis/Stipa thurberiana communities. Chestnut soils of the kipuka developed on loess show considerable influence of the residual basalt, and differences in aspect and depth are closely associated with the occurrence of the three plant communities. The kipuka is now protected and is being used for studies of sagebrush-grass ecosystems. Fluctuation in the relatively stabilized vegetation is evident with recent deterioration of Festuca and its replacement by Bromus tectorum, presumably a result of drought.

Trelease, S. F.; Martin, A. L.

1936

Plants Made Poisonous by Selenium Absorbed From the Soil

Botanical Review 2(7) :373-396

An excellent review of available information on the relationships between selenium and plants growing in seleniferous areas.

Tromble, J.M.; Renard, K.G.; Thatcher, A.P.

1974

Infiltration for Three Rangeland Soil-Vegetation Complexes

J. Range Management 27(4):318

A rotating disk rainfall simulator was used to examine infiltration-funoff relations from selected rangeland sites as influenced by a soil-vegetation complex. The simulator assisted in quantifying infiltration rates for different management practices on different soil types. Infiltration was greater for brush dominated plots than for either grazed plots or grass plots without grazing. Antecedent soil moisture decreased infiltration rates. Crown cover was approximately twice as much on brush plots as on grass plots and significantly influenced infiltration.

Tueller, P.T.; Robertson, J.H.; Zamora, B.

1971

The Vegetation of Nevada, A Bibliography

Nevada Agricultural Experiment Station, Reno, NV R78 31

Author arrangements covering general, taxonomy, ecology, applied botany, and paleobotany. Some manuscript material is included, as well as theses.

Turner, G.T.

1971

Soil and Grazing Influences on a Salt-Desert Shrub Range in Western Colorado

J. Range Management 24:31

Responses of vegetation and ground cover to winter grazing by livestock and to exclusion of livestock for 10 years were observed on soils derived from shale, sandstone, and a mixture of shale and sandstone. Although distinct soil-vegetation relationships were evident, changes attributable to grazing were relatively small. Vegetation and other cover on non-grazed range was practically the same at the end as at the beginning of the study. Overall reductions in galleta, shadscale, and snakeweed were attributed to drought, while differential responses of Salina wildrye, Gardner saltbush, Greenes rabbitbrush, and annual plants were ascribed to grazing. Inherently low site capability and subnormal precipitation were believed responsible for the general lack of response of vegetation to exclusion of livestock.

Unesco

1963

Analogs of Yuma Terrain in the Southwest United States Desert

Technical Report 3-630, Report 5. 2 vols. Also cited as AD-466 089/450 611.

No abstract available

Ungar, Irwin A.

1966

Salt Tolerance of Plants Growing in Saline Areas of Kansas and Oklahoma

Ecology, v.47 (1) :154

Analyses of soil salinity in Kansas and Oklahoma marshes indicate that the most salt-tolerant species have the widest salinity tolerance and can survive under low as well as high salinities. The less tolerant species are limited in their distribution to low and nonsaline areas.

University of Southern California

1958

An Annotated Bibliography for the Mexican Desert

Prepared under contract for U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi

No abstract available.

Valentine, K. A.; Norris, J. J.

1964

A Comparative Study of Soils of Selected Creosotebush Sites in Southern New Mexico

J. Range Management v.17 (1) :23

Communities in whch creosotebush (Larrea divaricata Car.) is dominant cover large areas of rangeland in the Southwest. The general aspect of most of these communities is that of an open stand of shrubs with little or no soil-protecting or forage-yielding ground cover. Their prevalence and persistence suggest that they represent the full potential of their environments for supporting vegetative cover. With reference to many of these communities in southeastern Arizona, New Mexico and Texas, however, several workers have indicated that this is not the case, but that a former grass cover has become greatly reduced and shrubs greatly increased in them (Gardner, 1951; Cooperrider and Hendricks, 1937; Whitfield and Beutner, 1938; Leithead, 1959 and Humphrey, 1958). Most workers appear to have considered these communities as grazing disclimax of the Desert Plains Grassland, but Humphrey (1958) considered that fire originally maintained the grassland against invasion and dominance by shrubs.

Vandermark, J.L.; Schmutz, E.M.; Ogden, P.R.

1971

Effects of Soils on Forage Utilization in the Desert Grassland

J. Range Management 24:431

This study was made in southeastern Arizona to determine some of the factors affecting utilization by cattle of no key species on three desert grassland soils. Results showed that macronutrient content of the soil and the plants, and corresponding utilization of blue grama (Bouteloua gracilis) and curlymesquite (Hilaria belangeri), were always significantly greater on the Pima bottomland soil than on the two upland soils, but they were not always significantly different between the two uplant soils. No consistent relationships were found between forage utilization and micronutrient, sugar or starch content in the plants.

Van Hylckama, T. E. A.

1968

Effect of Soil Salinity on the Loss of Water from Vegetated and Fallow Soil

International Association of Scientific Hydrology, publ. 83 :635-644

In the semiarid zone of the southwestern Unites States some six million hectares near washes and along rivers are covered by a dense growth of riparian or phreatophytic vegetation, consisting very often of pure stands of saltcedar (Tamarix pentandra). This vegetation, having a nearly unlimited access to water, transpires large quantities, estimated to total over 29,000 million cu km per year. In order to measure the actual rate of evapotranspiration 6 large evapotranspirometers (surface area about 80 sq m) were installed near Buckeye, Arizona in 1959 and another 5 in 1962. In 1963 the salinity of the groundwater in the older tanks had risen from an original 4 to over 200 parts per thousand. Although saltcedar is reported to tolerate and thrive on soil moisture of high salinity, the tanks were flushed out until the salinity of the effluent was back to the original. Whereas in 1963 the water use varied between 80 and 200 cu m per tank per year (depending on depth to water in the tanks), after flushing, the use increased by more than 50%. It is frequently assumed, when water use by phreatophytes is estimated, that the plants have access to water of low salinity. The data presented show that this assumption may not always be right and that the actual water losses may be less than estimated by as much as 40%. (See also W70-09580) (Knapp-USGS)

Vest, E. D.

1962

The Plant Communities and Associated Fauna of Dugway Valley in Western Utah

Univ. of Utah (Ph.D. dissertation) 134 p.

A report of a study of plant distribution in the valley. Describes biotic and edaphic factors affecting the distribution of 8 communities in the various local habitats.

Wagle, R. F., Vlamis, J.

1961

Nutrient Deficiencies in Two Bitterbrush Soils

Ecology v.42 (4) :745

The range of bitterbrush, Purshia tridentata (Pursh.) DC and Purshia glandulosa Curran, covers about 340,000,000 acres in the 11 western range states and southern British Columbia. P. glandulosa is limited to a small section of the Southwestern portion of this area and ranges into Baja California, Mexico. It is one of the most important range browse plants in the West (Hormay 1943). The soils upon which it grows have been studied very little.

This investigation extends some work begun in 1955 on the effect of environment on the early growth of bitterbrush and reported by Wagle (1958). The nutrient status of several bitterbrush soils was determined in this study by lettuce, other indicator plants, and bitterbrush seedlings, and used to interpret environmental effect on plant establishment.

Wainwright, Colin M.

1977

Sun-Tracking and Related Leaf Movements in a Desert Lupine (<u>Lupinus Arizonicus</u>)

Amer. J. Bot. 64(8) :1032-1041

Both diaheliotropic (sun-tracking) and paraheliotropic (cupping) leaf movements are described for the Arizona Lupine (Lupinus arizonicus (Wats.) Wats.). The leaf movements are shown to be non-circadian in nature. Evidence is presented than at active K+ ion transport mechanism is involved in these turgor-related leaf movements. Increasing concentrations of lanthanum, a known ion transport inhibitor, showed increasing inhibition of both leaf movements. Increasing concentrations of other salts did not inhibit either leaf movements, instead there was an increase in the cupping leaf movement (elevation of the leaflets) which is shown to be a water stress response.

Ward, H.S., Jr.

1949

Reactions of Adapted Legumes and Grasses on the Structural Condition of Eroded Lindley-Weller Soils in Southeastern Iowa

Ecol. Monographs, V.19, No.2

Contents

Man has been able to utilize plants in many ways to conserve soils. The development and use of dense foliage to protect the soils from the physical force of driving rain and wind, strong fibrous roots to prevent dislodgment of soil particles, and additions of organic matter from tops and roots to improve the productivity of soils have long been recognized. More recently some information has been obtained on how and to what degree plants change the physical structure of soils so that water infiltrates more readily, aeration is improved, and in general a more favorable edaphic environment is provided for the plants. This physical improvement seems to be derived in a large part from the formation of stable aggregates of soil particles.

Studies were initiated in 1941 to determine the effects of different species of grasses and legumes on the physical characteristics of severely croded Weller and Landley soils at Floris, Iowa. Samples were taken in 1941 from the surface soil layer of grass and legume plots established in 1939 for the purpose of evaluating these effects for a 3-year period.

A sampling was planned in 1944 after another 3 years. This writer was absent from the project from 1942 to 1946, so two more years elapsed than was planned for the second period. Records taken in 1946 producing comparisons of the relative effectiveness of legumes and grasses and of species within these two groups in restoring soil structure are presented in this paper. These changes in the soils were correlated with certain plant characteristics such as quantity and rate of decomposition of top and root material of the different species of plants.

Warnock, B.H.; Johnston, M.C.

1960

The Genus *Savia* (Euphorbiaceae) in Extreme Western Texas

The Southwestern Naturalist 5(1): 1-6

Key, synonymy, descriptions, and information on distribution and ecology are given for the two species recognized. These are *Savia phyllanthoides* (Nutt.) Pax & K.Hoffm. and *S. arida*, new species, with type from Brewster County, Texas.

Waterfall, U.T.

1946

Observations on the Desert Gypsum Flora of Southwestern Texas and Adjacent New Mexico

American Midland Naturalist, 36(2):456-466

Lists and discusses collections fo plants from desert gypsum areas in western Texas and eastern New Mexico. Notes that Coldenia hispidissima is characteristic of desert gypsum, and Larrea divaricata is characteristic of the adjoining calcareous deserts, also that some plants are obligate gypsophiles and can be used to indicate gypsum.

Wells, Philip V.

1959

An Ecological Investigation of Two Desert Tobaccos

Ecology v.40 (4) :626

Two species of Nicotiana are widespread in the deserts of intermountain western North America. Nicotiana attenuata Torr. dominates the cold deserts of the Great Basin, while N. trigonophylla Dun. is restricted to warm deserts from southern California to Texas and southward into Mexico. These species are rather mesophytic herbs with relatively thin, broad leaves. Nevertheless, both species have a long growing season and often attain a substantial size (over 1 meter), despite the very low rainfall over a considerable portion of their ranges.

An ecological study of these two species was made in the summers of 1956 and 1957 over most of their range in the United States. A total of 71 populations was investigated, 40 for N. attenuata and 31 for N. trigonophylla. The approximate locations of stations visited are indicated on the map in Figure 1. At each station, observations were made on physiography, elevation and surrounding vegetation, and at 58 stations, a soil sample was taken from around the roots of the tobaccos for subsequent analysis. Specimens from most of these populations are deposited for reference in the Duke University Herbarium. Also, all insects encountered on the tobacco plants were collected, and notes were taken on pollinators.

Went, F. W.; Westergaard, M.

1949

Ecology of Desert Plants. III: Development of Plants in the Death Valley National Monument, California

Ecology 30(1):26-38

The authors found differences in floristic composition due to salinity, altitude, and other causes. On dry slopes drought-enduring shrubs may be the only flowering plants except at intervals of 5 to 10 years when a moist season brings on a growth of annuals. They found that a rain followed by 30°C. temperature resulted in no germination; by 15 to 16°C., germination in only creosotebush; and by 8 to 10°C., germination of winter annuals but not creosotebush.

West, Neil E., Ibrahim, Kamal I.

1968

Soil-Vegetation Relationships in the Shadscale Zone of Southeastern Utah

Ecology v.49 (3) :445

Four distinctive units of landscape, soils, and vegetation occurring in a selected area within the shadscale zone of southeastern Utah are designated by the dominant plant species as the Atriplex confertifolia/Hilaria jamesii, Atriplex nuttallii var. nuttallii/Hilaria jamesii, Atriplex nuttallii var. gardneri-Aster xylorhiza, and Atriplex corrugata habitat types. The Atriplex confertifolia/Hilaria jamesii community occurs only on level pediment remnants where coarse-textured and well-developed soil profiles have been derived from sandstone gravel. Soils under this community were non-alkali throughout the profile. They were non-saline in the surface 2.5 ft but saline at greater depths. A distinct lime zone 9-16 inches thick occurs from 15 to 29 inches below the soil surface. The Atriplex nuttallii var. nuttallii/Hilaria jamesii community occurs on eroded pediment slopes where a shallow A1 vesicular horizon overlies a Ccs massive gypsiferous horizon and altered bedrock of Mancos shale. These profiles are loamy and non-alkali throughout. They are non-saline in the surface 15 inches but saline at greater depths. A gypsiferous horizon 7-17 inches thick occurs from 2 to 4 inches below the soil surface. The Atriplex nuttallii var. gardneri-Aster xylorhiza community occurs on lower Mancos shale badlands. The soil profiles found here are typically fine textured and non-alkali throughout. They are non-saline in the surface 12 inches but saline at greater depths. The Atriplex corrugata community is found in alluvial basins where materials from the other three habitat types have been deposited over Mancos shale. The soils of this habitat type are heavy textured and saline-alkali throughout the profile.

White, E.M.

1971

Some Soil Age-Range Vegetation Relationships

J. Range Management 24:360

Soil texture and development determine the kinds of range plants that grow in west central South Dakota. Bluestems, sideoats grama, and prairie sandreed are important species on very weakly developed soils but are less important on more strongly developed soils than cool-season mid and tall grasses. Western wheatgrass, green needlegrass, and buffalograss are important on well developed soils except those that are very coarse textured where needleandthread is important. Soil structure and fertility changes probably are the important factors affecting vegetation as a soil develops.

White, E.M.; Lewis, J.K.

1969

Ecological Effect of a Clay Soil's Structure on Some Native Grass Roots

J. Range Management 22:401

Dense Clay Range soils have larger structure peds or groups of smaller peds in the upper part of the soil when moisture is at the wilting point than do Clayey Range soils of the same moisture and clay content. Large peds, which are bordered by cracks when dry, apparently constrict roots as they dry and hold the roots so that they are stretched across the bordering cracks. Blue grama and buffalo grass grow on the Clayey Range soils and have a fine, spreading root system near the soil surface. However, these grasses do not grow on Dense Clay Range soils where presumably their fine roots are not strong enough to withstand the constricting and stretching forces. Western wheat grass and green needlegrass have larger, more deeply placed roots which are more vertically oriented than the short grasses and are able to utilize subsoil moisture and grow on the Dense Clay soils.

White, E. M., Gartner, F. R., Thompson, W. W.

1974

Content and Adsorption of Phosphorus in Black Hills Prairie and Forest Soils

Soil Science Soc. Amer. Proc. V.38 :965

Prairie areas within forested areas of the western United States have been attributed to the phosphorus content being higher or lower than the adjacent forested soils. Black Hills forest and prairie soils in South Dakota have about the same quantity of total and available P. Langmuir adsorption and desorption isotherms for PO_4P are not distinctly different for the prairie and forest soils, which suggests the chemical systems are the same in both soils. Thus, prairie areas in the ponderosa pine (Pinus ponderosa, Laws) forest of the Black Hills are not caused by differences in the phosphorus chemistry of the soils.

White, L.P.

1971

Vegetation Stripes on Sheet Wash Surfaces

J. of Ecology 59(2):615-622

Striped vegetation patterns occurring on sheet wash surfaces in arid and sub-arid zones are smooth surfaces on which the slope is too slight to allow rill or gully erosion, so that runoff occurs as sheet flow. Soils within stripes have thickened a horizons with improved permeability and surface moisture penetration; some have surface accumulations of permeable windblown material trapped by vegetation. In some cases there is marked leaching of soluble salts within arcs. Patterns are apparently highly stable when environmental conditions remain unchanged, placing them throughout the quaternary with migration during successive pluvials. At the arid margin of the zone, stripes have advanced onto sparsely vegetated ground.

Whitfield, C. J.

1933

The Vegetation of the Pike's Peak Region

Ecological Monographs v.3 (1) :76,77

Table of Contents

The Pike's Peak region lies in the east-central part of Colorado, about 38°30" north latitude and 106° west longitude. The mountain itself is approximately eighty miles by airline from the Great Continental Divide. It rises abruptly from the Great Plains to its high altitude in a little more than seven miles by airline. These facts give the region characteristics peculiar to itself, and have affected vegetational development.

Whittaker, R. H.

1960

Vegetation of the Siskiyou Mountains, Oregon and California

Ecological Monographs v.30 (3) :279

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Whittaker, R. H., 1960
Page Two

The Klamath Region, between the southern Cascade Range and the Pacific Ocean in southern Oregon and northern California, is an area of exceptional ecological interest. These old and geologically complex mountains support an exceedingly complex pattern of natural communities in relation to steep climatic gradients and diverse parent materials, and among these communities a prevailing climax, the Mixed Evergreen Forest, which has a central relation to other western forest vegetation. One area of the region, the Siskiyou Mountains along the California-Oregon border, was selected for vegetation study. Quantitative samples were taken over a wide range of topographic situations, climates, and parent materials for gradient analysis, seeking to relate distributions of plant populations and characteristics of communities to environmental gradients. Analysis and interpretation were based on the conception of the vegetation as a multi-dimensional pattern, and on study of the manner in which local patterns of vegetation in relation to topographic moisture gradients change along climatic gradients and from one parent material to another. The sections which follow include vegetation description, climax interpretation, community classification, floristic analysis, and consideration of species distributions for the pattern of Siskiyou forest vegetation in relation to four major environmental gradients--local topographic moisture, elevation, the diorite-gabbro-serpentine series of parent materials, and the east-west climatic gradient from the Pacific Coast inland.

Whittaker, R. H., Niering, W. A.

1965

Vegetation of the Santa Catalina Mountains, Arizona: A Gradient Analysis of the South Slope

Ecology v.46 (4) :429

Vegetation of the southwest slope of the Santa Catalina Mountains of south-eastern Arizona was sampled and transects prepared for 1,000-ft (305 m) elevation belts on granite and gneiss soils from the summit forests (2,440-2,750 m) to the base of the mountains (900 m). Transects also represented subalpine forests above 2,750 m in the Pinaleno Mts. and vegetation of the valley plain or bajada below the mountains, and samples were taken from volcanic soils below 900 m in the Tucson Mts.

Principal community-types from high elevations to low are: subalpine forest (Picea engelmanni in the Pinaleno Mts. and Abies lasiocarpa), montane fir forest (Abies concolor, Pseudotsuga menziesii), pine forests (Pinus ponderosa, P. strobiformis), pine-oak forests (P. ponderosa, Quercus hypoleucoides), pine-oak woodlands (P. ponderosa, P. chihuahuana, Q. hypoleucoides, Q. arizonica), pygmy conifer-oak scrub (Pinus cembroides, Juniperus deppeana, Q. arizonica, Q. emoryi, Arctostaphylos pringlei, A. pungens, monocot shrubs), open oak woodland (Q. emoryi, Q. oblongifolia, Vanquelinia californica, monocot shrubs, and grasses), desert-grassland (Agave schottii, Haplopappus laricifolius, and grasses), Sonoran desert of mountain slopes (north-slope shrub phase, and south-slope spinose-suffrutescent phase), upper bajada desert (cercidium microphyllum, Franseria deltoidea), and lower bajada desert (Larrea tridentata). Forests of canyons and arroyos are also described. Relations of communities to elevation and topographic moisture gradients are represented in a mosaic chart.

Physiognomic relations of communities are represented in charts of growth-form coverage in relation to elevation and topographic moisture gradients. Growth-form diversity increases from high-elevation forests strongly dominated by evergreen-needleleaf trees to desert of lower mountain slopes in which pinnate leguminous trees, spinose shrubs, suffrutescent semi-shrubs, and stem-succulents share dominance.

Among Raunkiaer life-forms hemicryptophyte species are most numerous at middle and higher elevations, phanerophyte species at lower elevations. In open oak woodlands and desert grasslands, phanerophytes, hemicryptophytes, and suffrutescent chamaephytes each make up about one-third of the perennial flora. Desert floras of mountain slopes are characterized by predominance of suffrutescent chamaephytes over both phanerophytes and hemicryptophytes, in large numbers of therophyte species.

Whittaker, R.H.; Niering, W.A.

1968

Vegetation of the Santa Catalina Mountains, Arizona, IV: Limestone and Acid Soils

J. of Ecology 56:523-544

Vegetation of limestone and acid soils are compared in detailed transect studies. In general, the limestone vegetation shows: more open and xeromorphic physiognomy; distributional displacements of species populations in relation to elevation and topography; different and more xeric species composition; similar life-form composition and species diversity, in this area; and different geographic affinities, with strong representation of Chihuahuan species. The limestone vegetation is regarded as climax and as forming a pattern as stable as, but conspicuously in contrast with, those on other soils. This contrast is most striking in areas of marginal forest and woodland climates.

Wiedeman, V. E., Penfound, Wm. T.

1960

A Preliminary Study of the Shinnery in Oklahoma

The Southwestern Naturalist v.5 (3) :117-122

Shinnery is scattered throughout the western third of Oklahoma principally on coarse soils derived from materials of the Pliocene and Pleistocene epochs. It occurs on sandy soils (Brownfield and Nobscott series) throughout the mixed prairie and short grass plains in a region of low precipitation (20 in to 25 in.). The most common species is Quercus Havardi, although Q. stellata, Q. Margaretta and Q. Mohriana are present. The shinnery constitutes an oak population of extreme hybridity with Q. Havardi x Q. stellata being the most common hybrids. Most stands of shinnery are two to four feet high, although the height may vary from one to 40 feet. Since no germination of acorns was observed, it is assumed that reproduction is accomplished largely by rhizones. Fire is utilized to control the height of the shin oaks and to promote an increase in forage whereas the herbicide 2, 4, 5-T, when used for three successive years, eliminates much of the shinnery.

Wilde, S.A.; Krause, H.H.

1960

Soil-Forest Types of the Yukon and Tanana Valleys in Subarctic Alaska

J. Soil Sciences 2(2)

The region consists of flood plains, river terraces, low mountains, and dissected plateaux. Much of the area is covered with wind-blown, micaceous silt and fine sand. The summer temperature of nearly 100° F drops in winter to -70°. The mean annual precipitation is about 12 in. The important types of forest soils include lithosols and regosols, alluvial soils, melanized raw-humus soils, micropodsols, half-bog soils, lowmoor peat, highmoor bog soils, and tundra-forest soils. Forest cover consists of white and black spruce, tamarack, paper birch, aspen, and tacamahaca poplar, accompanied by Sitka alder, willows, Alaska rose, highbush cranberry, many heath shrubs of both American and Eurasian origin, mosses (largely of Sphagnum and Hylocomium genera), and lichens. Spruce stands on productive loessial uplands and permafrost-free terraces yield as much as 15 Mbf. per acre. A comparatively rapid growth of trees on lithosols and regosols, attaining 0.3 cords per acre per year, is attributed to large differences between the day and night temperatures resulting in condensation of water on fissures and fragments of rocks. Highmoors, covering slopes up to 45°, and some half-bog soils support sporadic cover of dwarfed trees; these otherwise unproductive sites provide food and shelter for wildlife, an important item in Alaska's economy. The immediate neighborhood of highmoor peat and alkali solonchak soils, as well as the development of non-podzolic, melanized soils covered with thick raw humus, are among many paradoxes of the Alaskan environment.

Wilde, S.A.; Voigt, G.K.; Pierce, R.S.

1954

The Relationship of Soils and Forest Growth in the Algoma District of Ontario, Canada

J. Soil Science 5(1)

During the summer of 1952, the authors made a general survey of soils, groundwater, and forest cover on an area of approximately 250,000 acres, located in northern Ontario, at the intersection of the Algoma-Hudson Bay and Canadian Nat'l Railways. This area comprises level or undulating fluvioglacial and lacustrine deposits interrupted in places by rock outcrops and rugged ridges of terminal moraines. The extremely cold and humid climate owes its characteristics to the proximity of Hudson Bay, located at a distance of 150 miles. The average annual temperature is 35° F. The average temperature of the growing season, 63° F, is only 12° above the minimum established by Mayr (1909) for the timber line. The growing season is confined to June, July, and August, but even these months are not free from occasional frosts. The mean winter temperature is often close to 0° F. The annual precipitation approaches 30 in, nearly two-thirds of the rain falling during the summer months. The low rate of evaporation and abundant rainfall give rise to the wide occurrence of hydromorphic soils (Hills, 1944) which are underlain by ground water at a depth of less than four ft and dominate both the elevations and depressions. Otherwise, the soils of this region are strongly modified by the process of podzolization which is active in non-calcareous as well as lime-bearing substrata. From the stanpoint of management, the forests of the Algoma district have one serious disadvantage, their inaccessibility. This is primarily caused by extensive muskegs and shallow gley soils, natural obstacles to the construction of hard-surfaced roads. Outside of the winter months, transportation is limited to motor-driven speeders on narrow-gauge tracks, canoes on a few sluggish streams, and slow exhausting marches by foot. A low fire-hazard and the enormous capacity of all soils for natural regeneration are among the positive aspects of the region. In spite of the clear-cut deforestation at the end of the last centure, the forests in this part of Ontario form today an immense, uncharted green sea, extending for hundreds of miles.

Williams, G.; Gifford, G.F.; Coltharp, G.B.

1972

Factors Influencing Infiltration and Erosion on Chained Pinyon-Juniper Sites in Utah

J. Range Management 25(3):201-205

Relationships between vegetal and edaphic factors and infiltration rates and erosion as measured on 550 infiltrometer plots at chained Pinyon-Juniper sites in Utah were analyzed by multiple regression analysis. Those factors most important for predicting infiltration rates (regardless of time interval) included total porosity in the 0 to 3 in. layer of soil; percent bare soil surface; soil texture in the 0 to 3 in. layer of soil; and crown cover (percent or tons per acre). The ability to predict infiltration rates varied with time and geographic location. Not only did predictive ability vary, but independent variables explaining such variance also changed with time and location. Factors that influence sediment discharge were so variable from one geographic location to another that no consistent relation was found.

Williams, J.S.

1969

Gradients in Species Composition of Desert Vegetation Near El Paso, TX In C.C. Hoff and M.L. Riedesel, Eds., Physiological Systems in Semi-Arid Environments

Univ. of New Mexico Press, Albuquerque, NM P. 273-283

Gradients in species composition in plant communities are affected by a variety of interacting environmental factors that are often difficult to isolate and measure. In this paper vegetation, soils, climate, geology, and geomorphology of the Rio Grande Valley are described and historical records are reviewed. This area is an arid region with great phytographic diversity resulting mainly from various disturbing factors. It is subject to the formation of many new arroyos and deepening of older ones. Plant communities in the arroyos were surveyed, importance values of species determined, and species composition correlated with arroyo structure. Two important plants were Fouquieria splendens, whose presence delineated arroyo importance, and Larrea divaricata, which disappeared as arroyo deepening increased. Other important species were tabulated and their significance described. In terms of plant communities, four overlapping zones were observed as arroyo development progressed.

Wollum, A. G., II

1973

Characterization of the Forest Floor in Stands along a Moisture Gradient in Southern New Mexico

Soil Sci. Soc. Amer. Proc. v.37 :637

Forest floor properties of stands along a moisture gradient from dry, represented by a pinon-juniper stand (Pinus edulis Engelm--Juniperus scopulorum Sarg.), to wet, represented by a white fir stand (Abies concolor (Gordon & Glend.) Lindl.), were studied. Dry weights and amounts of nutrients were directly related to the moisture gradient. For example, dry weights of the forest floor increased from 9.4 to 80.8 metric tons/ha from the dry to the wet end of the moisture gradient, respectively. Nutrient concentrations were not related to the moisture gradient with the exception of K. In the more mesic stands sufficient water appears to have been present to allow substantial leaching of K from the forest floor.

Woodbury, A.M.

1933

Biotic Relationships of Zion Canyon, Utah with Special Reference to Succession

Ecological Monographs, V.3, No.2, p. 147

Contents

If one could have viewed the Zion Canyon region in southwestern Utah from some high aerial position continuously during the past fifty million years and preserved a record of the slow geological changes occurring below by taking a moving picture with one exposure say every thousand years, there would have been recorded in such a picture remarkable changes and transformations which led to the production of the now deep and narrow gorge, Zion Canyon. The net result of these changes and transformations and the striking feature of such a picture would be the movement of the canyon, plowing its way for 15 miles into the forest covered plateau with an ever-lengthening stretch of desert plain cut in two by the river and its fringing forest of decidous trees following in its wake.

This movement produces interesting consequences. The river cutting into the solid rock creates bare areas. Biologically speaking, nature abhors a bare spot. These bare areas are invaded by plants in an effort to gain a foothold, or may also be utilized by certain animals. The pioneer plants attacking the bare rock, accumulate a little soil making it possible for other plants to gain a foothold and crowd out the pioneers. As the rock crumbles and more soil accumulates, successive types of plants establish themselves and crowd out their predecessors until a climax formation is reached where the occupants cannot be displaced under normal conditions.

The presence of plants, furnishing basic food, makes it possible for vegetarian animals to exist. Coincidental with the successive changes in the plant development, come successive changes in the vegetarian animal life. The presence of vegetarian animals, furnishing the basic food transformed into animal products, makes it possible for parasites and carnivorous animals to exist.

As the canyon moves inexorably forward, the plant and animal communities of a given place pass through a series of stages from the coniferous forest on the plateau above through successive types represented in the canyon and finally reach the desert plain stage trailing in the wake. The problem of this work is to piece together the historical picture as a basis for understanding present conditions. The physical contour, the operative principles and the effective forces that exist as heritage from the past, all give clues which with proper interpretation and due allowance for modifying factors, should lead to a rational explanation based upon natural law.

Woodbury, Angus M.

1947

Distribution of Pigmy Conifers in Utah and Northeastern Arizona

Ecology v.28 (2) :113

The forest cover type of pinyon-juniper woodland locally known as pigmy forest or pigmy conifers consists of a mixture of scrub or pigmy trees belonging to the genera Juniperus and Pinus. The main bulk of the forest lies between altitudes of 5000 and 7000 feet but these boundaries are strikingly transgressed in many places and the forest within this range of altitude has so many interruptions and discontinuities that seldom can a large body of unbroken forest be found (fig. 6).

The upper limits of this forest are known to vary from about 6500 feet on north-facing slopes of the Kaibab Plateau in northern Arizona to approximately 8400 feet on south-facing slopes of the Book Cliffs in Carbon County, Utah. On the south end of the La Sal Mountains in San Juan County, the limit is reached near 7500 feet and in Cedar Canyon in Iron County, near 7800 feet.

The lower limits are ordinarily found near 5200 feet in many places both in the Great Basin and in the Colorado drainage. In the Virgin River basin in extreme southwestern Utah, this community extends downward as low as 3700 feet in many places such as in the Beaver Dam Mountains, near Gunlock and near Pintura, but in one place on the Ivins Bench about 3 or 4 miles northwest of Santa Clara, the limit is found about 500 feet lower at 3200 feet altitude.

Discontinuities within the forest occur mainly in valleys, canyons, mesas or shallow washes where the pigmy trees occupy the rough rocky or coarse soil areas and the finer soils of the bottoms bear other types of vegetation. These discontinuities tend to interrupt the general belting or zonation of the forest and in some cases upset the normal canted arrangement of the zone on opposite sides of a mountain.

This paper is intended as a contribution in helping to explain the factors governing the distribution of this comminity in Utah and northeastern Arizona. It is a by-product of many years of study of this forest as background material in animal ecology.

Wooddell, S. R. J., Mooney, H. A., Hill, A. J.

1969

The Behaviour of LARREA DIVARICATA (Creosote Bush) in Response to Rainfall in California

J. Ecology v.57

One of the most striking aspects of desert vegetation is the apparently regular spacing of shrubs. The species which has been commented on most in this respect is Larrea divaricata Cav., the creosote bush (Leopold 1963; Went 1952, 1955; Baker 1966). Its widereaching root system is referred to by Cannon (1911), who excavated several systems and showed that in some situations the roots could extend 2 or 3 m in all directions.

Such regular specing, if it exists (and casual observation certainly suggests that it does) must be the result of some sort of mutually disadvantageous interaction between the individuals. Went suggested that allelopathy was involved in this pattern in a widely quoted statement made in 1955: 'Another Death Valley plant endowed with a remarkable root system is the evergreen creosote bush. It has wide reaching roots which can extract water from a large volume of soil. The creosote bush is spread with amazingly even spacing over the desert; this is especially obvious from an aeroplane. The spacing apparently is due to the fact that the roots of the bush excrete toxic substances which kill any seedlings which start near it. The distance of spacing is correlated with rainfall; the less rainfall the wider the spacing. This probably means that rain leaches the poisons from the soil so that they do not contaminate so wide an area. We commonly find young creosote bushes along roads in the desert, where the road builders have torn up the old bushes.' Rainfall measurements have been carried out at many stations in the California desert for varying numbers of years. We chose our experimental sites as close as possible to rainfall stations, preferably stations where records had been kept for some years (see map, Fig. 1). Eight sites were samples in the Mojave Desert and four in the Sonoran desert. Each site was selected to be as near to the weather recording station as possible, to be on as level an area as possible, and to have minimum dissection by drainage channels.

Woodmansee, R.G.; Potter, L.D.

1971

Natural Reproduction of Winterfat (Eurotia lanata) in New Mexico

J. Range Management 24:24

In situ ecological factors influencing the natural reproduction of the important Western browse species winterfat (Eurotia lanata) were investigated in central and west-central New Mexico from summer 1967 to spring 1969. Seed of winterfat germinated in late winter and early spring on all slopes and in soils varying widely in origin and texture. Survival was greatest on disturbed soils which supported low vegetation that afforded some shelter but little shading for seedlings. The disturbed soils indicated greater moisture availability. Seedlings were tolerant to competition, and were often found in living clumps of grass. A comparison of vegetation on heavily grazed and protected ranges indicated winterfat was susceptible to heavy grazing, and reproduced when on protected or lightly grazed range dominated by low-growing grasses.

Yang, T. W.

1957

Vegetational, Edaphic, and Faunal Correlations on the Western Slope of the Tucson Mountains and the Adjoining Avra Valley

Univ. of Arizona (Ph.D. dissertation) 176 p.
BA32(10)32794

A very careful and comprehensive study in the mountains west of Tucson, Arizona. Found a highly significant correlation between each of the two major vegetation types and specific soil characteristics. The *Larrea* vegetation type is associated with a finer-textured soil, a higher amount of capillary moisture, but a relatively lower portion of that water available for plant use. The *Cercidium* vegetation type is associated with coarser-textured soil, a lower amount of capillary moisture, but a relatively higher portion of that water available for plant use.

Yang, T.W.; Lowe, C.H.

1956

Correlation of Major Vegetation Climaxes with Soil Characteristics in the Sonoran Desert

Science 123(3196):542

Soil characteristics determined from samples taken over a 14-mile transect, located on the western slope of the Tucson Mountains and the adjacent Avra Valley (elev. 3400 to 2000 ft) have yielded highly significant differences associated with two distinct climax vegetation types. The lighter and more rocky soil of the higher slopes supports the relatively complex Paloverde-Sahuaro (Cercidium-Cereus) vegetation type, whereas the finer soil of the lower slopes and valley supports the relatively simple Creosotebush-Bur sage (Larrea-Franseria) Association. From analysis of pertinent soil characteristics and their correlation with climax vegetation types of the Sonoran Desert, it is concluded that here specifically different soil attributes characterize, and are intimately associated with, distinctly different and major climax vegetation types existing under the same macroclimate.

Yeaton, Richard I., Travis, Joseph, Gilinsky, Ellen

1977

Competition and Spacing in Plant Communities: The Arizona Upland Association

J. Ecol. (65) :587-595

Spacing and competition were studied within and between species of the 'Arizona upland association' in Organ Pipe Cactus National Monument. Larrea tridentata, Franseria deltoidea, Opuntia fulgida, Carnegiea gigantea, and Fouquieria splendens comprise 95% of the individuals and 94% of the plant cover in the area studied. All intraspecific nearest-neighbour comparisons show that competition is occurring. Larrea tridentata competes with all species studied except Carnegiea gigantea, Franseria deltoidea competes only with Larrea tridentata, while there is no evidence of Carnegiea gigantea competing with other species (its interaction with Opuntia fulgida could not be determined).

The root system of Larrea tridentata occupies a position intermediate between and overlapping those of Franseria deltoidea and Opuntia fulgida and as a result competes with both. Opuntia and Franseria do not compete as their root systems are segregated vertically from each other in the soil. It is suggested that vertical separation of root systems is the mechanism through which interspecific competition is reduced and co-existence maintained between these associated species of plants.

Zinke, Paul J.

1962

The Pattern of Influence of Individual Forest Trees on Soil Properties

Ecology v.43 (1) :130,133

The soil under the influence of a forest develops properties that vary spatially with relation to the location of the trees. This variation in soil properties is frequently reflected in the distribution of the various species of the ground flora. The amelioration of degradation of the forest soil takes place with each tree as a center of influence. This paper reports the patterns of soil properties which develop under individual trees with examples drawn from work in the forested areas of California.

The pattern of soil properties under single forest trees is generally developed with radial symmetry to the tree, varying with distance from the tree trunk so that there is a systematic change in pH, nitrogen content, exchangeable bases, and exchange capacity and volume weights. The general pattern of this variability is due to the difference between the effect of bark litter, leaf litter, and the adjacent opening or neighboring tree. The patterns obtained are predictable in a given forest region.

ADDITIONAL LITERATURE CITATIONS AND ABSTRACTS

Aase, J.K.; Wight, J.R.

1970

Energy Balance Relative to Percent Plant Cover a Native Community

J. Range Management 23:252

Net radiation (R_n) and evapotranspiration (ET) were poorly correlated during both a "wet" and a "dry" period on native range near Sidney, Montana within each of five levels of vegetational cover. The ratio ET:R_n fluctuated greatly in all cases and was generally higher during the period of higher rainfall. During dry periods, substantial amounts of energy were dissipated as heat flux to the atmosphere. Maximum evaporation and/or transpiration from 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent cover occurred for 12 days after rainfall and was, respectively, 0.7, 0.8, 1.1, 0.3, and 1.9 times the evaporation from a Class A evaporation pan. Total evapotranspiration for the season was 21 percent lower and dry matter production was 14 percent higher with 50 percent cover than with complete cover. Water use from 75 percent and 25 percent cover was similar to that from 50 percent cover, but forage yields were 5 percent and 14 percent less, respectively, than from complete cover.

3 7 6

Adams, D.R.; Radosevich, S.R.

1978

Regulation of Chamise Shoot Growth

Amer. J. Bot. 65(3): 320-325

Nutritional, hormonal, and environmental control of chamise (Adenostoma fasciculatum H.& A.) shoot growth was investigated. In vitro culture of shoot tips demonstrated that 0.18 M sucrose was required for optimum apical growth. Cytokinin (benzyladenine) promoted shoot growth at otherwise growth-limiting sucrose concentrations and induced uptake of sucrose from the basal medium. Abscisic acid inhibited growth of cultured shoot tips induced by high sucrose concentration or cytokinin. In the field, inhibition of shoot growth was a function of water stress. These studies indicate that the effects of water stress on chamise shoot growth may be mediated by changes in carbohydrate, cytokinin, or growth inhibitor levels at the shoot apex.

Anthony, M.

1954

Ecology of the Opuntiae in the Big Bend Region of Texas

Ecology, Vol.35, No.3

One of the richest but least known of our southwestern cactus areas lies in Trans-Pecos Texas, where the Rio Grande, in a giant curve, delimits a large portion of basin and range country known as the Big Bend Region. With great topographic diversity offering habitats for a wide variety of forms, this area makes an excellent meeting ground for faunal and floral forms of four adjacent biotic provinces.

Taxonomic analysis of natural populations of Opuntiae, recognizing 31 species, hybrids and varieties (Table I), necessarily accompanied these observations of ecological relationships but will be published elsewhere.

A total of eleven months was spent in the field, from February to June in 1947, and from March to October in 1948. Living and dried material was collected and ecological relationships noted at each station and along all roads. The dried material is in the Herbarium of the University of Michigan. Living duplicates were kept in a greenhouse at the Botanical Gardens of the University of Michigan from 1947 to 1949, in order to test the constancy of vegetative characteristics under uniform conditions.

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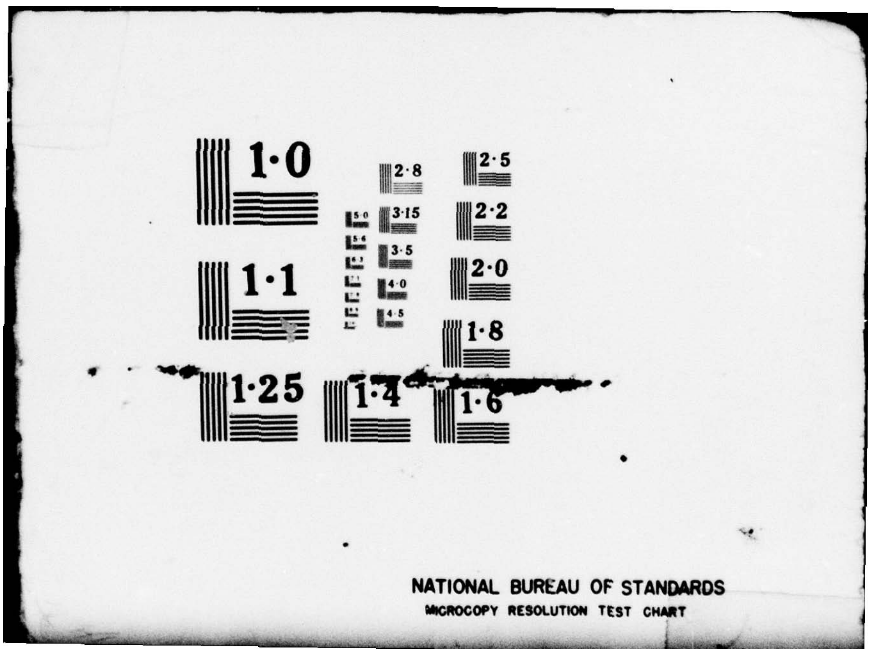
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MICROCOPY RESOLUTION TEST CHART

Bauer, H.L.

1930

Vegetation of the Tehachapi Mountains, California

Ecology, V.11, No.2, p. 263

The Tehachapi Mountains connect the southern end of the Sierra Nevadas with the Coast Ranges of California, extending a distance of about 50 miles and located over 100 miles inland from the Pacific Ocean (Fig. I). They constitute the only mountainous connection in California between the Sierras and the Coast Range except in the northern extremity of the state in the vicinity of the Siskiyou Mountains. Thus the Tehachapis are a path of plant migration between the two larger chains of mountains, migration of mountain species being impossible elsewhere because of the low, arid Great Valley barrier. The extent of previous consideration of this region appears to have been limited to some incidental collecting by a few botanists.

Bogusch, E.R.

1950

A Bibliography on Mesquite

Texas J. of Sci. 2(4):528-538

Some 100 literature sources, covering scattered references to mesquite (Prosopis spp.) as far back as 1767, are reviewed. Diaries and journals of travelers indicate that the mesquite has occupied much of its present range in the US for at least a century. Such spread as has occurred has resulted in an increased density dhiefly. Uses for the beans and the wood are enumerated along with its food value to animals.

Brown, H.E.

1958

Gambel Oak in West-Central Colorado

Ecology, V.39, No.2

Growing in a belt along the hillsides of western Colorado are several million acres of brush. Gambel oak (Quercus gambellii Nutt.) is the most common brush species, occupying about one million acres in nearly pure stands. Near its lower elevation limit at about 7,000 feet the oak is associated with pinyon pine and juniper, while at elevations approaching 9,000 feet it mingles with aspen and spruce.

Oak brush has long been a subject of controversy. Many land managers look at the brush-covered hillsides and see the importance of oak in stabilizing the soil, in retarding snow-melt, and in providing browse for deer and elk. Some of these observers are actually experimenting to find ways of increasing oak brush. Others look at these same hillsides and see oak stands too dense for their livestock to graze. They see oak bruch using water and nutrients in deep, fertile soils that might otherwise be producing more forage for their cattle and sheep. They wish to kill the oak brush and replace it with grass and forbs. Further controversy exists regarding the successional position of oak brush. Some persons contend that it has spread and thickened since the early days of settlement and represents a secondary stage in succession while others consider it to be a relatively stable climax.

The study reported here is intended to help reconcile these views by providing (1) information concerning the characteristics of oak brush and its environment in west-central Colorado, and (2) evidence as to whether the extent and density of oak brush are changing now or have changed since the time of early settlement.

341

Cable, D.R.

1972

Fourwing Saltbush Revegetation Trials in Southern Arizona

Forest Service (USDA), Tucson, Ariz. Rocky Mountain Forest and Range Experiment Station, Journal of Range Management, Vol.25, No.2, p. 150-153

Fourwing saltbush (Atriplex canescens), one of the most widely distributed and important shrubs in western ranges, has been used for revegetation many times with varying degrees of success. Exploratory studies designed to determine some of the environmental limitations for establishment of the plant in the semiarid southwest were conducted for 4 years on an experimental range in southern Arizona. The long-range goal was to replace some species of little or no grazing value with a highly desirable forage species. The saltbush was seeded and transplanted into native stands of almost pure creosotebush and of velvet mesquite with a burroweed understory. The shrubs were killed by picloram spray and by grubbing. Although it was shown that saltbush survival was higher on creosotebush sites with calcareous soils and that transplants survived better on grubbed plots than on sprayed or check plots, after 3 years the trials had to be considered failures from the standpoint of permanent establishment. It is possible part of the failure was due to germination and seedling mortality because the experiment was conducted during drought years. This indicates a need for moisture conservation. There was higher emergence on mesquite-alive than on mesquite-killed plots which is rather surprising in view of the well-known ability of mesquite to use available soil moisture at the expense of associated plants.

Cannon, W.A.

1925

Physiological Features of Roots With Especial Reference to the Relation of Roots to the Aeration of the Soil

Carnegie Inst. of Washington, Publ. 368, 168 p.

The major emphasis of this publication is on root growth in relation to a deficiency of oxygen or an excess of carbon dioxide. Data are presented from experiments with various Sonoran Desert plants: Larrea tridentata, Krameria, Prosopis juliflora, Fouquieria splendens, and others.

Cottle, H.J.

1931

Studies in the Vegetation of Southwestern Texas

Ecology, V.12, No.1, p. 105

The Grassland Formation of North America for many years has been a center for ecological study. Numerous extensive and intensive investigations have been made, but the area is so vast that for some sections there is even no reconnaissance work. The present investigation deals with the grasslands of southwestern Texas, especially in their relation to grazing. A study has been made of the structure of the vegetation. The recovery of the vegetation from the harmful effects of overgrazing has been investigated by means of chart and clipped quadrats both inside and outside of exclosures. A portion of the Trans-Pecos region, just north of the Rio Grande, and centering about Alpine, 225 miles southeast of El Paso and 100 miles north of the Mexican border is the area studied.

3414

Crum, H.; Steere, W.C.

1958

Some Bryophytes from Baja California

The Southwestern Naturalist 3:114-123

As a member of the Sefton-Stanford Expedition of 1952 to Baja California and the off-shore islands, the junior author collected a surprising number of mosses and hepatics in the extremely forbidding habitats available on Los Cedros (26 spp.) Cerralvo (6 spp.) and Partida (2 spp.) Islands and also on the mainland at Bahia de los Muertos (1 sp.). Taxonomic and distributional notes accompany the species reported, and novelties include Aloina pilifera (BSG) n. comb. (for Barbula rigida var. pilifera BSG) and Crossidium seriatum n.sp. (from Los Cedros Island). Both the latter are illustrated.

Daubenmire, R.F.

1942

An Ecological Study of the Vegetation of Southeastern Washington and Adjacent Idaho

Ecological Monographs, V.12, No.1, p. 53

Contents

The vegetation of the unforested regions in the Pacific Northwest has been less thoroughly studied and is consequently less perfectly understood than that of the forested areas.

Agricultural development began in southeastern Washington only about 50 years ago (Strahorn et al. 1920) but is expansion has been so rapid and complete that few typical remnants of the original prairie and desert remain. These relics of the primeval vegetation likewise seem to be heading toward nearly complete extermination within a few years, so that the time is opportune for obtaining statistical records of these communities. Moreover, as the irrigation project connected with the Grand Coulee Dam is developed, a better understanding of the natural vegetation types of the Big Bend area should deal practical application in land classification.

The area covered by the present survey is limited on the east by segments of the Snake and Clearwater Rivers, and by the forested foothills of the Bitteroot Mountains. The north and west boundaries follow the Spokane and Columbia Rivers, and the southern edge is determined by the southern boundary of Washington and the forested slopes of the Blue Mountains (Fig.1).

The desert-like western half of this area lies in a great bend of the Columbia River, and is locally referred to as the "Big Bend" country. The eastern half, the prairie region which borders the Bitterroots from Spokane to the Blue Mountains, is widely known as the "Palouse Region." The term Palouse is believed to have been derived from the French, meaning lawn or greensward, and to have been first applied to the region by early Jesuit missionaires (Rees, 1918). A century ago, trappers referred to this unforested plain as the "plateau of the Spokane" (Van Osdel, 1915, p. 160). Physiographically it is known as the Walla Walla section of the Columbia Plateau (Fenneman, 1931).

The aim of the present study is to enumerate and characterize the principal natural plant associations of the region, to indicate the particular portion of the region covered by each, and to point out some of the environmental factors which may control this vegetational pattern.

347

Eckert, R.E., Jr.; Bruner, A.D.; Klomp, G.J.

1973

Productivity of Tall Wheatgrass and Great Basin Wildrye Under Irrigation on a Greasewood-Rabbitbrush Range Site

Agricultural Research Service, Reno, Nev., Plant Science Research Div., Journal of Range Management, Vol.26, No.4, p. 286-288.

In the Humboldt River basin of northern Nevada, the replacement of some 394,000 acres of greasewood and rubber rabbitbrush with forage plants of high economic value would salvage a large portion of the 103,000 acre feet of water estimated to be used yearly by those non-beneficial phreatophytes. In this study tall wheatgrass and great basin wildrye were spring-seeded on the range site and established by sprinkler irrigation. An evaluation of the longevity and productivity of these seeded species under different irrigation regimes was made and showed that weekly irrigations for 2-3 years were required to establish potentially productive stands of the seeded species. The highest production of tall wheatgrass and great basin wildrye was obtained 3 years after seeding with weekly irrigations of 1.25 inches of water, the wheatgrass being the more productive. Productivity with limited water or without water was reduced by the chemical properties of the saline-sodic soil, while root growth was restricted by the physical characteristics of the soil.

348

Gibble, W.P.

1950

Nineteen Years of Vegetational Change in a Desert Habitat

Univ. of Arizona, M.S. Thesis, 20 p.

A belt transect on the grounds of the Carnegie Desert Laboratory in 1930 was remapped in 1949 to determine vegetational changes. Three plant communities were included in the transect: a Larrea association, a Hilaria association, and a grass-shrub association. Few changes occurred in the Larrea association. The Hilaria association showed an increase in grasses, and a decrease in shrubs. Shrubs increased in number in the mixed grass-shrub association, but decreased in area. Nine of 31 acacia plants recorded in 1930 were dead by 1949; two of nine Larrea plants, and 16 of 43 Calliandra plants died during the same period. Franseria delididea and Krameria grayi both showed definite increases. Total grass cover decreased in spite of the establishment of large numbers of Bouteloua trifida. Opuntia spinosior and O. fulgioa increased even though the area was protected from grazing by domestic livestock. There were fewer but larger plants of Aristida in both the Hilaria and the mixed grass-shrub associations in 1949 than in 1930.

Griffin, J.R.

1965

Digger Pine Seedling Response to Serpentinite and Non-Serpentinite Soil

Ecology, V.46, No.6

Seedlings were grown from 17 seed samples collected throughout the natural range of Pinus sabiniana in California. Five collections came from soils derived from ultrabasic serpentinized rock. The seedlings were grown in a greenhouse in cans filled with two different soils. One series of 36 seedlings per sample grew in a fertile, loamy sand forest soil. This planting was replicated in a sterile, highly serpentinized soil gathered at one seed collection site. Significant differences in shoot and root growth were found between populations within each soil treatment. But the relative ranking of populations was similar in both cases. On both soils populations of non-serpentinite origin made the most vigorous growth. Seedlings from the serpentinite soil collection locality made relatively poor growth in the serpentinite soil. No adaptation to the serpentinite soil conditons by populations which came from serpentinite areas was suggested. All seedling populations appeared to have a high tolerance for extreme serpentinite conditions. The correlation between mean seed size and mean seedling size was low (r=0.24) in the fertile soil, but much higher (r=0.68) in the serpentinite soil.

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Hayward, H.E.; Bernstein, L.

1958

Plant-Growth Relationships on Salt-Affected Soils

Botanical Review, v.24

Numerous reports dealing with plant responses on salt-affected soils have appeared since the earlier review of this subject in this journal by Magistad (143). In the interim, Hayward and Wadleigh (99), Hayward (93) and Grillot (78) have reviewed segments of the literature in this field. The present article proposes to bring together published material from some areas, notably Japan and Russia, which have been somewhat neglected in previous reviews along with the more commonly available publications. Because of language difficulties, the authors have attempted a selective review of Russian and Japanese papers rather than complete coverage.

Heady, H.F.; Bartolome, J.

1977

The Vale Rangeland Rehabilitation Program: The Desert Repaired in Southeastern Oregon

USDA For. Serv. Resour. Bull. PNW-70, 139 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Discusses the initiation, execution, and outcome of an 11-year program of range rehabilitation on public domain lands in southeastern Oregon. Initiated primarily to benefit the livestock industry, the investment of $10 million in range improvements also profoundly affected other multiple uses. The analysis of this large and successful program should serve as a useful guide for monitoring other range programs.

Hodgkinson, H.S.; Young, A.E.

1973

Rough Fescue (Festuca scabrella Torr.) in Washington

J. Range Management 26(1):25

In Washington, rough fescue occurs primarily north of the 47° latitude and east of the Cascade Mountains. There are two large, well-represented areas. Other locations are represented by small areas, some containing only scattered plants. Rough fescue is very palatable and should be managed as the key species when it makes up more than 15 percent of the total plant composition. To maintain or improve good stands, no more than 50 percent of the annual current year's growth should be removed.

355

Hurd, R.M.

1961

Grassland Vegetation in the Big Horn Mountains, Wyoming

Ecology, Vol.42, No.3

Grasslands cover approximately one-third of the 1.1 million acres within the Bighorn National Forest in north-central Wyoming. Most of the remaining area is forested. Grasslands are even more extensive in the Big Horn Mountains at the lower elevations where climate does not favor the development of forests. These mountain grasslands have furnished summer grazing to range livestock since the 1880's. Jack (1900), describing the livestock operations on the Bighorn National Forest and adjacent ranges, mentioned that large areas were intensively used by sheep, although cattle also were grazed.

The grasslands have continued to be an important range resource to the local livestock economy. In addition to their direct contribution to the range livestock industry, mountain grasslands and intermingled forested areas have supplied water, forest products, habitat for game, and recreation. These contributions have been recognized and prized for many years.

There is no quantitative description of the vegetation before the range was grazed by domestic livestock; however, there are some accounts of the vegetation, geology, and soils. Darton's monograph (1906) thoroughly treats the geology of the area and Love et al.(1955) supplement this work. Darton mentions gross points about the vegetation but generally in a cursory manner. Jack (1900) discusses the general appearance of the vegetation and the relative importance of some species as forage plants for cattle and sheep. General soil characteristics are described by Thorp et al.(1939) and Dunnewald et al.(1939), and details on organic matter, phosphorous content, and timber-grassland soil characteristics are reported by Dunnewald (1929, 1930). Other references to some earlier accounts of the vegetation and inpressions of the area are cited by Hurd and Kissinger (1952).

Recent work in this area has contributed quantitative information, particularly on the herbaceous vegetation and its management. In a preliminary report Hurd and Kissinger (1952) presented data on composition and production of vegetation, growth and development of several grasses, and pre-preference and use of the vegetation by livestock. Beetle (1956) recognized a difference in vegetative patterns within this area and between this and adjacent areas. He presented a modified list of species and the estimated cover for the most common ones. Generally, his estimates of cover pertain to ranges currently being grazed by either cattle or sheep. He also described and interpreted the influence of past use by livestock and game upon the vegetation.

This report provides quantitative information to aid in the more intensive management of these and similar ranges. Results are presented from inventories of grassland stands in the 7,000-8,500 ft elevetation zone which has been grazed by cattle for many years and is commonly called "cattle range."

Johnsen, T.N., Jr.

1962

One-Seed Juniper Invasion of Northern Arizona Grasslands

Ecological Monographs, V.32, p. 188

Table of Contents

The invasion of grasslands by junipers has been documented by various workers (Foster 1917, Miller 1921, Emerson 1932, Cottam & Stewart 1940, Parker 1945, Wolff 1948a).

A number of workers have advanced opinions as to causes for the spread of junipers (Phillips 1910, Foster 1917, Miller 1921, Leopold 1924, Emerson 1932, Schoffelmayer 1939, Cottam & Stewart 1940, Parker 1945, Wolff 1948a, Allred 1949). The most commonly stated causes have been (i) lack of periodic fires which would kill many small trees and some large ones, (ii) increased spread of seed by livestock (iii) overgrazing and resultant reduction in competition of grasses with the seedling junipers, and (iv) shift in climate favoring the woody species. Little consideration has been given to characteristics of the tree which would affect its successful invasion of grasslands.

This study deals with the invasion of Arizona grasslands by one-seed juniper (Juniperus monosperma), a tree native to the southwestern United States. The invasion was considered to occur in four stages: (i) migration, (ii) ecesis, (iii) aggregation, and (iv) establishment of dominance. Since each of these stages is completed by or through individual plants, emphasis was placed on characteristics and factors which would affect the individual tree.

Larsen, J.A.

1930

Forest Types of the Northern Rocky Mountains and Their Climatic Controls

Ecology, V.11, No.4, p. 631

The purpose in this report is to describe the natural forest types of the northern Rocky Mountains in Montana and northern Idaho, to point out their natural distribution and chief silvical characteristics, and to show in what degree they are controlled by differences in topography and climate. Such information may be useful in laying the foundation for later, more intensive silvical investigations and practices in a region rich in forest resources.

356

Livingston, R.B.

1952

Relict True Prairie Communities in Central Colorado

Ecology, V.33, No.1, p. 72

The grassland communities of the plains region of Colorado have been studied rather extensively during the past fifty years. There are, however, no reports of relict communities of the true prairies on the Colorado plains, either within the mixed prairie association or within the montaine forest communities which extend onto the plains.

The climax vegetation of the Colorado plains is the mixed prairie (Whitfield 1933; Weaver and Clements 1938). Grassland communities make up the vegetative cover of the region with the exception of an extension of the montane forest onto the plains near the summit of the divide which separates the South Platte and Arkansas rivers. This extension of the montane forest is locally known as the Black Forest. During the early phase of an investigation of the Black Forest and adjacent mixed prairie grasslands (Livingston 1949), many communities were observed which were dominated by species typical of the true prairie. These communities occurred both within the forest and at lower altitudes in the adjoining mixed prairie grassland northeast of Colorado Springs. Detailed studies were made of these relict communities to analyze their floristic composition and to determine if possible what factors might permit their maintenance in this semi-arid region where the mixed prairie is the climax.

Looman, J.

1963

Preliminary Classification of Grasslands in Saskatchewan

Ecology, Vol.44, No.1

A classification of the vegetation types in the Saskatchewan grasslands is proposed. As a unit of classification the association sensu Braun-Blanquet was adopted. This association, characterized by a combination of kensorts, is easily recognized in the field and may be considered a good ecological indicator.

The classification presented is based on more than 700 species-presence lists from which the associations and kensorts were isolated by means of statistical comparisons. The prearrangement of the species lists in a vegetational continuum, divided into intervals, can serve as an objective basis for the comparisons and results in a considerable saving of labor.

Correlation of occurrence of species, when used to construct vegetation models, shows clustering of species which are considered kensorts of associations or higher units.

Quantitative samples taken in different associations and ordinated statistically show an arrangement in accordance with the quantities of species represented in the samples. The arrangement obtained conforms to the units already established. Ordination of quantitative samples from stands in a single association gives valuable information on the ecology of the stands, especially the influence of soil, and utilization.

The associations form several vegetational continua, spatial as well as temporal, in which only the initial associations (on sharply contrasting habitats) are mutually discontinuous. In theory, the successional continua may be considered to converge towards one climatic vegetation type.

The classification proposed is not in conflict with either dynamic ecology or the concept of the individualistic association. The associations are considered to be equivalent developmental phases and are therefore not static. The stands, comprising the synthetic associations, are "individuals" of which no two are identical, but which are united in an association on the basis of floristic similarity.

The validity of the association as a vegetational unit in the strictest sense is of little importance to the practical value of the association as a regional classification unit.

Merkle, J.

1952

An Analysis of a Pinyon-Juniper Community at Grand Canyon, Arizona

Ecology, V.33, No.3, p. 375

During July and August of 1949, data were obtained for a phytosociological analysis of a portion of the Pinus-Juniperus woodland (Pinus edulis-Juniperus spp.) on the Coconino Plateau in Grand Canyon National Park, Arizona. The Pinus-Juniperus zone (Daubenmire 1943) extends from Mexico to country south of the Snake River in Idaho while communities dominated by Juniperus alone continue as far north as southern Canada.

It has been described floristically and qualitatively by several workers. Weaver and Clements (1938) and Oosting (1948) briefly discuss the community in textbooks. Shantz and Zon (1924), in addition, mention some associated plants. Woodbury (1933, 1947), Rasmussen (1941), Emerson (1932), Philips (1909), Graham (1937), Howell (1941) give more detailed descriptions of this community in the southwest, especially Arizona, New Mexico, and Utah. Stoddart and Smith (1943) discuss the community from a range management standpoint.

Howell obtained quantitative data from large sample plots (30.61 acres with 39 plots) in northern New Mexico and northeastern Arizona to determine volume, growth, and yield of these woodlands. He presents data on number of trees per acre, percent of total number of trees, percent of total basal area, and percent of total volume for Pinus edulis (Colorado pinyon), Juniperus monosperma (one-seed juniper) and Juniperus scopulorum (Rocky Mountain juniper). He describes 3 types based on percent of basal area: pinyon type with Pinus edulis having more than 60 percent of the total basal area, juniper type with Juniperus having more than 60 percent of the total basal area, and mixed type with neither having 60 percent of the total basal area. Pinus was generally in greater numbers in all three types. Because of limited time available, the present investigation was confined to those areas actually covered and dominated by P. edulis and Juniperus (Fig.2); therefore, some plants listed by other workers in the community as a whole were not sampled.

The nomenclature of most of the plants follows that of Kearney and Peebles (1942). The nomenclature of Penstemon is that supplied by Dr. F.W. Pennell of the Philadelphia Academy of Sciences.

Merkle, J.

1962

Plant Communities of the Grand Canyon Area, Arizona

Ecology, Vol.43, No.4

During the summers of 1949-55 ecological studies were made of the vegetation of Grand Canyon National Park, including both the South Rim and the North Rim as well as portions of the Kaibab National Forest. Reports on two of the communities have been published: the pinyon pine-juniper (Merkle 1952) and the spruce-fir (Merkle 1954). This paper defined three principal communities: 1) that dominated by ponderosa pine on the South and North Rims; 2) that dominated by white fir and ponderosa pine on the North Rim; and 3) the meadows of the higher parts of the North Rim. These communities are all within the limits of the montane forest which occurs in the Rocky Mountain region and on the east side of the Cascade and Sierra Nevada ranges from 4,000 to 7,000 ft. in the north and from 6,000 to 9,000 ft in the south (Rydberg 1915, Shantz and Zon 1924, Weaver and Clements 1938, Daubenmire 1943, 1952, Oosting 1948, and Billings 1951). On the Coconino Plateau (South Rim) and the Kaibab Plateau (North Rim) this forest ranges from about 7,000 to 8,700 ft in altitude. The pinyon-juniper community occurs below 7,000 ft and the spruce-fir community above 8,700 ft. The meadows studied occur in shallow valleys on the Kaibab Plateau.

Mitchell, W.W.; Evans, J.

1966

Composition of Two Disclimax Bluejoint Stands in Southcentral Alaska

J. Range Management 19:65

The composition of two disclimax bluejoint stands was determined prior to their being committed to grazing use in southcentral Alaska. The stands were essentially monotypic in their grass constituency with forbs and woody species comprising over 50 percent of the shoot density and well over 60 percent of the yield. Bluejoint was the only plant of grazing value found in quantity in the two communities.

361

Orme, A.R.; Bailey, R.C.

1971

Vegetation Conversion and Channel Geometry in Monroe Canyon, Southern California

California Univ., Los Angeles, Dept of Geography; and Forest Service (USDA), South Lake Tahoe, Calif.
Association of Pacific Geographers, Yearbook, Vol.33, p. 65-82.

Studies of the adjustments of channel geometry to hydrological fluctuations linked to physical factors are common, but studies in which changes in vegetation cover are related to alteration of variables affecting channel geometry are rare. Monroe Canyon, situated along the margins of the San Dimas experimental forest was placed under intensive management in 1958 in an effort to increase water yield. The original geomorphology, stream hydrology, vegetation and climate of the canyon are described. In 1958 and 1959, 17 HA of riparian woodland were removed from the canyon floor. In 1960, a lightning fire consumed almost all of the chaparral vegetation of the slopes. After the fire, a portion of the watershed was sprayed with herbicides and a seeded annual grass cover was established on 57 HA of slopeside while the remaining area was allowed to revert to chaparral. The riparian woodland clearance resulted in decreased transpiration and increased streamflow. The areas converted to grass experienced greater soil instability and slippage and decreased interception, resulting in greater runoff. In subsequent years, stream discharge rates and sediment loads evidenced remarkable fluctuations and after the rainy seasons the canyon became clogged with debris. Not only were changes in the longitudinal profile noteworthy, but changes in the cross-channel profile were quite spectacular, particularly where less cohesive materials margined the channel. Today the channel survives as a debris-filled relict feature. It is concluded that the channel's capacity for self-regulation was destroyed.

362

Parker, J.

1952

Environment and Forest Distribution of the Palouse Range in Northern Idaho

Ecology, V.33, No.4, p. 451

Moscow Mountain and the immediately adjacent hills, known as the Thatuna or Palouse Range, occupy a position between the heavily forested mountains of northeastern Idaho and the plains of eastern Washington and nearby Idaho. Coniferous trees largely dominate the range (Fig.1) but some half-dozen species are well enough represented and of similar enough requirements so that the distribution seems quite complex. Closer examination of the area, however, shows transitions from one species or group of species to another as the topography changes in certain respects.

Patten, D.T.

1968

Dynamics of the Shrub Continuum Along the Gallatin River in Yellowstone National Park

Ecology, V.49, No.6

Willows dominate the shrub vegetation along the Gallatin River and with the other shrubs show different growth and mortality responses relative to their position from the river and other environmental factors. The shrub species form a continuum from the river to the dry grassland depending upon the varying moisture regime. The sequence of shrub species from wet to dry appears to be Salix farrae, S. lutea, S. drummondiana, S. exiqua, Artemisia cana, and A. tridentata. Individual species also vary in their ability to survive present environmental pressures, including periodic heavy browsing.

Robertson, J.H.

1971

Changes on a Sagebrush-Grass Range in Nevada Ungrazed for 30 Years

J. Range Management 24:397

Thirty years rest enabled a 20-acre tract of eroded sagebrush-grass range in northern Nevada to increase its vegetal cover in all life forms. The cover of perennial forbs increased the most, 85 percent. Thurber needlegrass increased sevenfold. Only annual forbs and locoweed declined. Bluebunch wheatgrass was reestablishing naturally in favored spots. Newly cleared and seeded range outside the exclosure produced three times as much as grass forage as produced after long rest without clearing.

365

Saunier, R.E.; Hull, H.M.; Ehrenreich, J.H.

1968

Aspects of the Drought Tolerance in Creosotebush (Larrea divaricata)

Plant Physiology 43:401-404

Biochemical adaptations to drought conditions were studied in creosotebush (Larrea divaricata) collected in three localities in the Chihuahuan Desert. After a year of growth under greenhouse conditions, 48 randomly selected plants were divided into two groups. One was subjected to water stress for seven days and the other to optimum watered conditions. At the end of the treatment period the leaves were analyzed for amino acids, using a Beckman Model B 120 Amino Acid Analyzer and soluble sugars were determined using paper chromotography. In the stressed plants, glucose and sucrose concentrations were reduced while fructose was not changed significantly. Amino acids were increased, especially proline and amino acids in the pyruvic acid families. Alanine and Valine, which are synthesized from pyruvic acid may have had an ammonia storage function during wilting. This increase was attributed to protein hydrolysis and not translocation from roots. A relationship was suggested between drought tolerance and loss of soluble sugars (possibly increased krebs cycle activity) and increased foliar accumulation (possibly synthesis) of amino acids.

366

Schmutz, E.M.; Smith, D.A.

1976

Successional Classification of Plants on a Desert Grassland Site in Arizona

J. Range Management 29(6):476

Vegetative cover, composition, and frequency studies on protected and grazed desert grassland ranges in Arizona provided quantitative data on the reaction of plants to protection and grazing. These data were used to classify plants as decreasers, increasers, and invaders on a deep upland desert grassland site. In the absence of fire or mesquite control, velvet mesquite, Arizona cottontop, sideoats grama, cane beardgrass, and poverty threeawns reacted as decreasers; Wright buckwheat, red threeawn, and Rothrock grama acted as increasers; and burroweed, sticky snakeweed, and Lehmann lovegrass were classified as invaders. Annuals were not measured, and perennial forbs were too limited in abundance to classify. Under climax conditions with recurring fires, all native species apparently reacted as above except mesquite, which reacted as an increaser on bottomlands and an invader of uplands.

Shreve, F.

1922

Conditions Indirectly Affecting Vertical Distribution on Desert Mountains

Ecology, Vol.III, No.4, October

Differences in altitude carry with them differences in so many of the physical conditions affecting organisms that for many years we will have a rich field for ecological investigation in the study of these conditions, and of the relation in which they stand to the distribution and activities of plants and animals, including man. Dissimilarities in the character of the altitudinal changes, whenever any two separated regions are compared, add still further complexity to the series of problems which is presented by the biota of mountainous areas. The influence of altitude per se-that is, of differences in barometric pressure-has been studied by animal physiologists, but has yielded no conclusive results of importance at the hands of plant physiologists. It is the altitudinal differences of insolation, temperature, rainfall, humidity, evaporation, and a score of related conditions that make up what we were formerly pleased to call "the factor of altitude."

The desert areas of the southwestern United States offer an excellent field for the investigation of life and conditons as influenced by altitude, not only on account of the numerous mountains of all orders of magnitude, but also because the region has been so little disturbed by the activities of man. For several years the writer has been engaged in a study of the vertical distribution of plants in southern Arizona, with particular reference to the Santa Catalina Mountains, near Tucson, but with numerous visits to other mountains in Arizona and adjacent states. The principal aim of this work has been to bring together, on the one hand, data regarding the vertical distribution and upper and lower limits of vegetations and characteristic species, and, on the other hand, to determine the altitudinal gradients of some of the physical conditions of greatest importance to organisms. By the correlation of these two sets of data it is possible to determine the limiting groups of conditions with a precision which is at least akin to that secured in a series of cultures grown under controlled conditions.

Shreve, F.

1925

Ecological Aspects of the Deserts of California

Ecology, Vol.VI, No.2, April

Students of the distribution of living organisms find within the broad boundaries of California a wide diversity of natural conditions, and many cases in which striking contrasts exist within relatively small areas. The influence of environmental conditions in determining the distribution and activities of the biota are of the greatest interest, whether the objects of study be plants, the lower animals or man. The various groups of native organisms have inhabited the area so long that they are now definitely distributed with relation to the environmental complex. Although man has migrated so recently into the state, we can nevertheless see many respects in which his distribution and activities have also been determined by the great elemental factors which make up the controlling conditions for his life. In a coastal belt 25 miles in width is to be found over three-fourths of the population of California. In a belt of equal width along the Colorado River and the eastern boundary is found less than one percent of the population. This great contrast-chiefly but not solely due to the environmental conditions-finds a parallel in the distribution of plants and the lower animals as well. It is within my province to speak only of the region in which the conditions are severe, the organisms relatively sparse, and the human migrants few.

369

Smith, W.K.; Nobel, P.S.

1978

Influence of Irradiation, Soil Water Potential, and Leaf Temperature on Leaf Morphology of a Desert Broadleaf, Encelia Farinosa Gray (Compositae)

Amer. J. Bot. 65(4): 429-432

Laboratory experiments were performed to evaluate observed seasonal changes in leaf morphology of the desert perennial shrub, Encelia farinosa Gray. Plants were grown under low or high conditions of photosynthetically active irradiation, soil water potential; and leaf temperature (8 different experimental regimes). The relative growth rate, leaf water vapor conductance, leaf water potential, and leaf length were all greater for the high regimes, the largest leaves occurring at low irradiation. High irradiation during growth led to thicker leaves with a higher internal to external leaf area ratio; low tended to increase somewhat. High irradiation also led to decreased absorptance to solar irradiation caused by increased pubescence. High leaf temperature during development resulted in slightly smaller, thicker leaves with higher A/A. Thus, irradiation appeared to have its major influence on leaf thickness, and absorptance, with a secondary effect on leaf length; affected primarily leaf length, growth rate, and water status, and secondarily A/A. Results are discussed with regard to recent ecophysiological studies on the observed seasonal changes in leaf morphology of E. farinosa.

Unesco publication

1960

Plant-Water Relationships in Arid and Semi-Arid Conditions: A New Unesco publication

Arid Zone Research Series Symposium #15

At its thirteenth session (Karachi, November 1957), the Advisory Committee on Arid Zone Research, recommended the compilation of a review of research on the relationships between plants and water in arid and semi-arid conditions, in the hope that such a review would serve as background information material for the symposium which was organized jointly by Unesco and the Spanish authorities and held in Madrid from 24 to September 1959. The proceedings of this symposium will constitute the next volume in the Arid Zone Research series.

The outline of this review has been prepared and the authors have been chosen with the assistance of Dr. R.O. Whyte, Chief of the Crop Production and Improvement Branch, Plant Production and Protection Division of FAO. In order to facilitate the task of the authors, the Secretariat made available to them general reviews of recent Russian work in this field, specially prepared for the purpose by Professors P.A. Henkel and B.P. Stroganov, to whom Unesco wishes to express particular thanks.

The volume contains the following nine reports: The income and loss of water in arid and semi-arid zones, by F.L. Milthorpe; Soil water relations in arid and semi-arid conditions, by W.R. Gardner; Physiological and morphological changes in plants due to water deficiency, by O. Stocker; Adaptation to drought: xerophytism, by H.R. Oppenheimer; Methods of research on water relations, by F.E. Eckardt; The management of native vegetation in arid and semi-arid regions, by R.M. Moore; Principles of dry land crop management in arid and semi-arid zones, by Sterling A. Taylor; Significance of fallow as a management technique in continental and winter-rainfall climates, by W.J. Staple; Principles of irrigated cropping, by Robert M. Hagan and Yoash Vaadia. There are 256 pages and abundant bibliographical references.

Unesco publication

1962

Plant-Water Relationships in Arid and Semi-Arid Conditions: Proceedings of the Madrid Symposium

Arid Zone Research Series Symposium #16

The water balance of plants and the complex relations between water, soil and plants, in arid and semi-arid conditions, are among the most important subjects of study for arid zone research. Following a recommendation of the Advisory Committee on Arid Zone Research, Unesco published a review of research on this question, and organized jointly with the Spanish authorities a symposium which was held in Madrid from 24 to 30 September 1959. Fifty-two specialists from 19 countries participated.

The proceedings of this symposium, No.XVI in the Aris Zone Research series, have just been published, and are on sale through Unesco national distributors. The volume contains 36 papers presented at the symposium and a short summary of the discussions. The papers are given in their original language (English or French), followed by summary in the other language and a summary in Spanish. They are grouped in five sections, as follows: I. Methodology of water relation studies on plants; II. Water sources for plants; III. Water balance of plants under arid and semi-arid conditions; IV. Drought resistance of plants; V. Practical applications to agronomy. A complete list of these papers will be found in Arid Zones, No.6.

As a direct outcome of the symposium, an attempt has been made to achieve some standardization of the terminology used in discussing plant-water relations. A paper prepared by S.A. Taylor and R.O. Slatyer on this subject has been included in the Proceedings volume.

Unesco publication

1970

Methodology of Plant Eco-Physiology. Proceedings of the Montpellier Symposium

Arid Zone Research Series Symposium #25

Eco-physiology, in the meaning of the term used in this work, is the science which studies the relationships between living beings and their environment, these relationships being considered from the point of view of teleology, causation or description. In this connexion it includes the study not only of structural and functional characteristics linking plants and animals to their natural setting, but also of all phenomena of transport and transformation of energy and mass taking place within eco-systems.

Eco-physiology is thus easily divisible into two branches. The first, teleology, is concerned with characteristics of adaptation developed during evolution, the second, the causal or descriptive group, relates to functional processes and their relationships with the physical and biotic environment.

If modern eco-physiology is to develop, research workers must have a more and more extensive knowledge of physics, especially of the mechanics of fluids, transfer of heat and thermodynamics, and they must have undergone a sound technological training. In addition, they need large experimental areas at their disposal, covered with natural or cultivated vegetation typical of the various climatic zones of the world. It is also important for these areas to carry bio-meteorological stations with modern measuring and registration equipment.

The progress of eco-physiology is thus dependent on both the training of research workers and the financing of research. Any project for organizing or promoting this science therefore necessarily entails an approach to governments and international organizations with the object of emphasizing its economic role as a basic science of agriculture, sylviculture and horticulture. But such an undertaking requires research workers to agree beforehand on the exact scope of eco-physiology in order to prove its existence as a separate science.

A symposium on the methodology of plant eco-physiology was held at the Botanical Institute of the University of Montpellier (France) from 7 to 12 April 1962, under the chairmanship of Professor L. Emberger, Director of the Institute. This meeting was sponsored by Unesco and the International Union of Biological Sciences (see Arid Zone, No.16, p.3). The primary object of the symposium was to promote inter-disciplinary collaboration in the field of the methodology of plant eco-physiology. The subjects discussed were under three headings--environmental factors, physiology of

plants considered individually and physiology of vegetation cover--and this division has been kept in the new publication. To prevent the theme of the symposium from becoming too generalized and diffuse, the programme dealt only with the methodology of the eco-psysiology of the higher plants.

Vale, T.R.

1975

Presettlement Vegetation in the Sagebrush-Grass Area of the Intermountain West

J. Range Management 28(1):32

Twenty-nine journals and diaries were reviewed for their vegetation descriptions of the sagebrush-grass area in an attempt to assess the relative importance of herbaceous plants and woody brush in the northern Intermountain West. The early writings suggest a pristine vegetation visually dominated by shrubs. Stands of grass apparently were largely confined to wet valley bottoms, moist canyons, and mountain slopes, with more extensive areas in eastern Oregon near the Cascade Range. The major area was apparently covered by thick stands of brush.

575

Walker, B.H.; Wehrhahn, C.F.

1971

Relationships Between Derived Vegetation Gradients and Measured Environmental Variables in Saskatchewan Wetlands

Ecology, Vol.52, No.1, p. 85

Thirty-four relatively undisturbed stands of vegetation in shallow marsh, slightly saline wetlands in south-central Saskatchewan were examined with respect to environmental influence on species distribution. Four environmental gradients account for the bulk of variation in the vegetation. They are, in decreasing order of importance, disturbance (despite the fact that all stands chosen are relatively undisturbed), available nutrients, water regime, and salinity. The greatest variation in the data from these stands as a whole is in their salinity, but this is not reflected in the vegetation. The correlation between water regime and available nutrients is negative. A number of other factors show minor correlations with the vegetation and with each other. The method of application of principal components analysis used in this study was a valuable aid in the interpretation of the data. It provides estimates of the proportions of 1) the variance associated with each principal component and 2) the total variation in the vegetation data that can be assigned to variation in the environmental measurements.

Wardle, P.

1968

Engelmann Spruce (Picea Engelmannii Engel.) at its Upper Limits on the Front Range, Colorado

Ecology, Vol.49, No.3, p. 483-484

Engelmann spruce is the dominant tree at timberline in the Front Range at approximately 3,350m elevation; it occurs as krummholz in the forest-tundra ecotone up to about 3,500m and occasional individuals are found in the tundra up to 3,730m. Temperatures decrease with increasing altitude above timberline, whereas wind velocity increases, especially during winter. Winter snow is deeper and persists longer in the forest than in the krummholz above, its depth in the latter tending to remain constant once the lower portions of the plants are packed. Soil temperatures fluctuate widely beneath tundra vegetation in the neighborhood of krummholz plants, whereas under forest variations are small and there is a prolonged period in spring when they remain within 0.6°C (1°F) of freezing point.

Krummholz growth forms of spruce arise through death of needles and shoots exposed to the prevailing westerly winds. Even in summer young exposed needles tend to be somewhat chlorotic, and many show lesions. In winter windward needles dry out, become bleached, and are eventually shed. Certain needles, instead of becoming bleached during winter, turn brown and dry out in early spring. In krummholz, even within a single shoot, sharply contrasting differences develop in winter between leeward needles that show only small seasonal decreases in water content, and windward needles that dry out and die. Desiccation is usually confined to krummholz, mainly affecting small needles on stunted shoots and the distal needles of long, robust shoot, but in the winter of 1961-62, following a cold, wet September, it extended to leading shoots of saplings below timberline. Replenishment of water in needles during winter is probably from water stored in sapwood above the snow pack, since sapwood beneath the snow pack remains frozen in both forest and krummholz.

Late-lying snow delays the spring growth of seedlings below timberline, but they occur even where snow persists until late in June. Above timberline, spruce seems to be less tolerant of late-lying snow.

It is concluded that though the position of timberline is correlated with summer temperatures, dry winter winds are the immediate, though probably not the ultimate, cause of the krummholz growth forms in the forest-tundra ecotone.

377

Went, F.W.; Westergaard

1949

Ecology of Desert Plants. III. Development of Plants in the Death Valley National Monument, California

Ecology, V.30, No.1, p. 26

The most extreme desert climate in the United States is found in Death Valley (see map, fig.1), on the border between California and Nevada. Therefore it is an interesting place to check the conclusions reached regarding the ecology of desert plants in less extreme deserts (Went, '48,'49).

The dryness of Death Valley is due to its location in the southerly part of the Great Basin lying between the Sierra Nevada and Rocky Mountains. To the north and south, hundreds of kilometers of desert country with numerous mountain ranges isolate it; the storms coming predominantly from the west have lost their moisture against the highest parts of the Sierra Nevada and further intervening mountain ranges (Argus and Panamint Mountains), and towards the east other high mountains and plateaus separate it from continental air that is already arid.

Went, F.W.; Westergaard

1949

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